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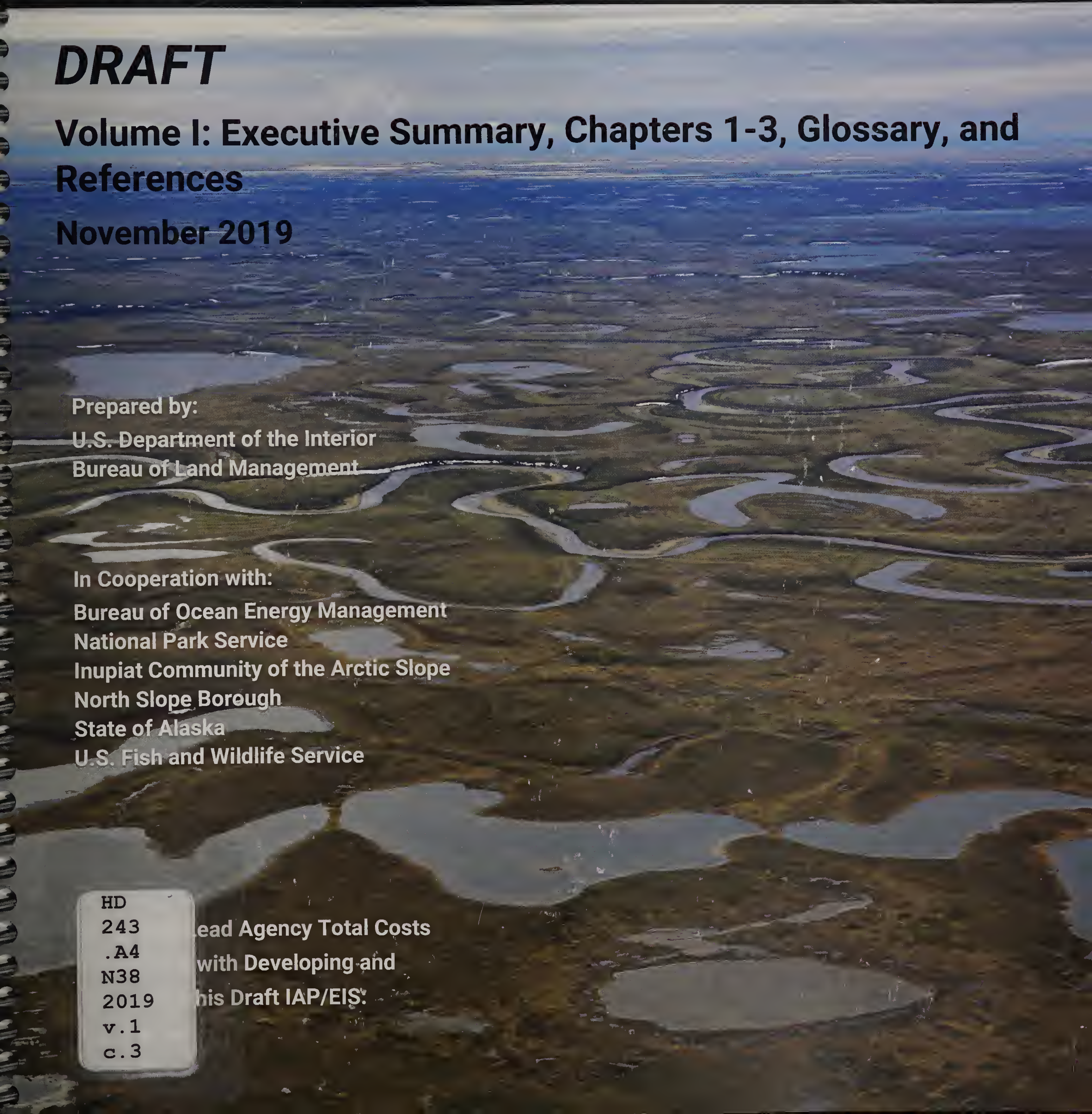
National Petroleum Reserve in Alaska

Integrated Activity Plan and Environmental Impact Statement



DRAFT

Volume I: Executive Summary, Chapters 1-3, Glossary, and References

November 2019

Prepared by:
U.S. Department of the Interior
Bureau of Land Management

In Cooperation with:
Bureau of Ocean Energy Management
National Park Service
Inupiat Community of the Arctic Slope
North Slope Borough
State of Alaska
U.S. Fish and Wildlife Service

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ead Agency Total Costs
with Developing and
his Draft IAP/EIS:

Mission

To sustain the health, diversity, and productivity of the public lands for the use and enjoyment of present and future generations.

Cover Photo: Northeast National Petroleum Reserve in Alaska.
Photo by Bob Wick (BLM).

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National Petroleum Reserve in Alaska

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Volume I: Executive Summary, Chapters 1-3, Glossary, and References

Prepared by:
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Iñupiat Community of the Arctic Slope
North Slope Borough
State of Alaska
U.S. Fish and Wildlife Service

Estimated Lead Agency Total Costs Associated with Developing and Producing this Draft IAP/EIS:

$2,684,000

United States Department of the Interior

BUREAU OF LAND MANAGEMENT
Alaska State Office
222 West Seventh Avenue, #13
Anchorage, Alaska 99513-7504
www.blm.gov/alaska

In Reply Refer To:
1793 (930)

November 2019

Dear Reader:

I am pleased to present the National Petroleum Reserve-Alaska (NPR-A) draft Integrated Activity Plan/Environmental Impact Statement (IAP/EIS) for your review. This draft IAP/EIS addresses a list of issues and contains a range of four alternatives for the Bureau of Land Management's (BLM's) future management of nearly 23 million acres of public land in the NPR-A. Decisions to be made as part of this plan include the availability of oil and gas leasing, availability for new infrastructure development, a determination of special area boundaries, and consideration of new or revised lease stipulations and required operating procedures.

The alternatives in the IAP/EIS are discussions of lease stipulations and required operating procedures designed to mitigate impacts on natural resources and their uses. All future on-the-ground actions requiring BLM approval, including potential exploration and development proposals, will require further National Environmental Policy Act analysis based on the site-specific proposal.

The BLM will consider and evaluate all comments in the preparation of this plan and will address substantive comments in the final IAP/EIS, scheduled to be released in 2020. The most useful comments are specific to the document and address one or more of the following:

- Identification of new information that would have a bearing on the analysis
- Inaccuracies or discrepancies in information or any errors in our portrayal of the resources and uses of the planning area
- Suggestions for improving management direction, consistent with the purposes of the National Petroleum Reserves Production Act and Secretarial Order 3352
- Identification of new impacts, alternatives, or potential mitigation measures

When you share your comments with us, please be as specific as possible. Identify the specific concern or correction you are suggesting, where it appears in the draft IAP/EIS, and the modification you feel is necessary or appropriate.
I appreciate your comments on the draft IAP/EIS; there are four ways for you to submit them:

- Electronically at https://bit.ly/2LA0Aos

- By fax to (907) 271-5421
- By mail to

  Stephanie Rice
  Project Manager
  BLM Alaska State Office
  222 West 7th Avenue, #13
  Anchorage, AK 99513
- In person at the BLM Public Information Center, located on the first floor in the James M. Fitzgerald United States Courthouse and Federal Building, 222 W. 7th Avenue, Anchorage, Alaska; at the BLM Public Information Center at 222 University Boulevard, Fairbanks, Alaska, or at any of the public meetings.

The 60-day public comment period for the NPR-A draft IAP/EIS begins with the Notice of Availability published by the Environmental Protection Agency in the *Federal Register*. The precise dates of the comment period, as well as information about public meetings, will be posted on the project ePlanning website at: https://bit.ly/2LA0Aos.

Submitted comments will be publicly available and may be published as part of the final IAP/EIS. Before including your address, phone number, email address, or other personal identifying information in your comment, be aware that your entire comment, including your personal identifying information, may be made publicly available at any time. While you can ask us in your comment to withhold your personal identifying information from public review, we cannot guarantee that we will be able to do so. All submissions from organizations and businesses and from individuals identifying themselves as representatives or officials of organizations and businesses will be available for public inspection in their entirety.

For additional information about the public comment process or the NPR-A IAP/EIS, please go to the project website at https://www.blm.gov/planning-and-nepa/plans-in-development/alaska/npr-a-iap-eis

Sincerely,

Chad B. Padgett

Chad Padgett
State Director

National Petroleum Reserve—Alaska
Draft Integrated Activity Plan and Environmental Impact Statement

Lead Agency: United States (US) Department of the Interior, Bureau of Land Management (BLM)

Cooperating Agencies: Bureau of Ocean Energy Management, Inupiat Community of the Arctic Slope; National Park Service; North Slope Borough; State of Alaska; and US Fish and Wildlife Service

Proposed Action: Revise the National Petroleum Reserve—Alaska (NPR-A) Integrated Activity Plan (IAP)/Environmental Impact Statement (EIS) to determine the appropriate management of all BLM-managed lands in the NPR-A in a manner consistent with the Naval Petroleum Reserves Production Act of 1976 (NPRPA), as amended, and Secretarial Order 3352.

Abstract:

The new NPR-A IAP/EIS will inform the BLM's compliance with Secretarial Order 3352, which directs the development of a schedule to "effectuate the lawful review and development of a revised IAP for the NPR-A that strikes an appropriate balance of promoting development while protecting surface resources."

The NPR-A IAP/EIS considers three action alternatives and the No Action Alternative (Alternative A). It would continue current management as approved in the February 2013 NPR-A IAP Record of Decision. The action alternatives (Alternatives B, C, and D) include a mix of lease stipulations and required operating procedures that contain measures to avoid or mitigate surface damage and minimize ecological disturbance throughout the planning area.

BLM Alaska developed the range of alternatives presented in the IAP/EIS, in coordination with cooperating agencies. In addition, the alternatives address the public's concerns expressed during the formal scoping period and issues raised during consultation with North Slope Inupiaq tribal governments and ANCSA Native corporations. These include potential effects from future activities on climate and meteorology, air quality, noise, physical geography, geology and minerals, petroleum resources, paleontological resources, sand and gravel, soil, water, solid and hazardous waste, vegetation and wetlands, wildlife, landownership and uses, cultural resources, subsistence uses and resources, sociocultural systems, environmental justice, recreation, visual resources, eligible and suitable Wild and Scenic Rivers, wilderness characteristics, transportation, public health, and the economy.

Review Period: The review period on the NPR-A Draft IAP/EIS is 60 calendar days. The review period began when the EPA published a notice of availability in the Federal Register on November 22, 2019. The comment period ends on January 21, 2020.

Further Information: Contact Stephanie Rice of the BLM at (907) 271-3202 or visit the NPR-A IAP/EIS website at https://bit.ly/2LA0Aos.

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ACRONYMS AND ABBREVIATIONS	Full Phrase
AAAQS	Alaska Ambient Air Quality Standards
AAC	Alaska Administrative Code
ADEC	Alaska Department of Environmental Conservation
ANCSA	Alaska Native Claims Settlement Act
ANILCA	Alaska National Interest Lands Conservation Act of 1980
AO	Authorized Officer
BLM	Bureau of Land Management
BMP	best management practice
CFR	Code of Federal Regulations
EIS	environmental impact statement
EPA	US Environmental Protection Agency
ESA	Endangered Species Act of 1973
GMT1	Greater Mooses Tooth 1
GMT2	Greater Mooses Tooth 2
IAP	integrated activity plan
ITR	incidental take regulation
kHz	kilohertz
LOA	letter of authorization
MMPA	Marine Mammal Protection Act
NAAQS	National Ambient Air Quality Standards
NEPA	National Environmental Policy Act of 1969
NMFS	National Marine Fisheries Service
NPR-A	National Petroleum Reserve-Alaska
NSB	North Slope Borough
NSO	no surface occupancy
NWI	National Wetland Inventory
PDO	Pacific decadal oscillation
PFYC	potential fossil yield classification
PL	Public Law
RFD	reasonably foreseeable development
ROD	record of decision
ROP	required operating procedure
ROW	right-of-way

	Full Phrase
TCH	Teshekpuk Caribou Herd
U.M.	Umiat Meridian
U.S.	United States
USC	United States Code
USFWS	US Fish and Wildlife Service
USGS	US Geological Survey
VRI	visual resource inventory
VRM	visual resource management
VSM	vertical support member

Executive Summary

INTRODUCTION

In accordance with the Naval Petroleum Reserves Production Act of 1976, as amended, the Bureau of Land Management (BLM) Alaska State Office, Anchorage, Alaska, has prepared a new Integrated Activity Plan and Environmental Impact Statement (IAP/EIS) for BLM-managed lands within the National Petroleum Reserve in Alaska (NPR-A). The Naval Petroleum Reserves Production Act of 1976 (42 United States Code [USC] 6501), as amended, excludes the NPR–A from the application of Section 202 of the Federal Land Policy and Management Act (FLPMA) (43 USC 1701), as amended, which is the basis for the BLM's resource management plans. The BLM conducts planning within the NPR-A with an IAP. The BLM complies with all applicable laws in the preparation of the IAP, including the National Environmental Policy Act of 1970 (NEPA), Endangered Species Act of 1973, Marine Mammal Protection Act of 1972, and the National Historic Preservation Act of 1966.

PURPOSE AND NEED

The BLM is undertaking a revision to the NPR-A IAP/EIS to determine the appropriate management of all BLM-managed lands in the NPR-A in a manner consistent with existing statutory direction and Secretarial Order 3352. Secretarial Order 3352 directed the development of a schedule to "effectuate the lawful review and development of a revised IAP for the NPR-A that strikes an appropriate balance of promoting development while protecting surface resources." The Naval Petroleum Reserves Production Act of 1976, as amended, and its implementing regulations require oil and gas leasing in the NPR-A and the protection of surface values consistent with exploration, development, and transportation of oil and gas.

In 2016, the community of Barrow formally changed its name to Utqiaġvik, the traditional Iñupiaq name. Hereafter in this IAP/EIS the community of Barrow is referred to as Utqiaġvik.

DECISIONS TO BE MADE

This revised IAP/EIS includes consideration of a range of leasing alternatives that make lands available for leasing, examination of current special area boundaries, and consideration of new or revised lease stipulations and required operating procedures. The IAP/EIS would ensure that the BLM's land management will provide the opportunity, subject to appropriate conditions developed through a NEPA process, to construct pipelines and other necessary infrastructure to bring oil and gas resources from offshore or adjacent leases to the Trans-Alaska Pipeline System or a future gas pipeline from the North Slope. The IAP/EIS would also consider the potential for a road or other transportation system connecting communities across the North Slope. This plan will supersede the 2013 NPR-A IAP Record of Decision, and depending on the alternative selected, may supersede the 2008 Colville River Special Area Management Plan, as amended by the 2013 update. The decisions evaluated in this IAP/EIS and its record of decision would authorize lease sales, but would not authorize any on-the-ground activity associated with the exploration or development of oil and gas resources or other land uses in the NPR-A.

PLANNING AREA

The planning area includes all lands and only such lands as are managed by the BLM in the NPR-A. The decision area includes only the surface land and subsurface mineral estate in the planning area over which the BLM has authority to make land use and management decisions. These BLM-managed lands total approximately 22.5 million acres of surface and subsurface estate. Nearly 234,000 additional acres of subsurface estate are under the Alaska Native Claims Settlement Act (ANCSA) village corporation surface estate (see **Table ES-1** and **Map 1-1** in **Appendix A**).

Table ES-1
Decision Area

Lands Affected by this Plan	Acres
Federal surface estate and federal subsurface estate	22,520,000
Federal subsurface estate with nonfederal surface estate	234,000
Total	**22,754,000**

Source: BLM GIS 2019
Note: Acreages are rounded up or down to the nearest 100 acres.

The IAP/EIS does not make decisions about:

- Surface or subsurface estates owned by ANCSA regional or village corporations
- The subsurface oil and natural gas estate of the North Slope Borough near Utqiaġvik
- Lands retained by the U.S. Navy near Point Barrow (Tract #1)
- The surface lands within (a) certified Native allotments owned by private individuals, (b) the airstrip at Umiat (owned by the State of Alaska), and (c) lands owned by the North Slope Borough near Cape Simpson

The boundary of the NPR-A is as described in Executive Order 3797-A of February 27, 1923. The northern portion of the eastern boundary of the NPR-A is along the western bank of the Colville River. That boundary is defined in Executive Order 3797-A as the "highest highwater mark…on the [western] bank," which the U.S. District Court for the District of Alaska construed to be "on and along the bank at the highest level attained by the waters of the river when they reach and wash the bank without overflowing it" *(Alaska v. U.S.*; case no. A78-069 Civ. December 7, 1984). Thus, neither the Colville River nor its banks immediately adjacent to the river downstream from approximately longitude 156°08′ are in the NPR-A.

The southern part of the eastern boundary of the NPR-A is a line at approximately longitude 156°08′ from the Colville River south to the crest of the Brooks Range. The southern boundary of the NPR-A lies along the top of the Brooks Range to approximately longitude 161°46′, which composes the NPR-A's western boundary from the Brooks Range to the Chukchi Sea. The northern NPR-A boundary encompasses the bays, lagoons, inlets, and tidal waters between the NPR-A's outlying islands and the mainland, thus accounting for over 429,000 acres of submerged estate within the NPR-A. The U.S. Supreme Court (in *U.S. v. Alaska*; No. 84, Orig. decided on June 19, 1997) determined that the NPR-A included these tidally influenced waters and that those waters and the submerged lands underlying them did not transfer to the State of Alaska at statehood.

SCOPING AND ISSUES

The BLM conducted formal scoping for the NPR-A IAP/EIS following publication of a Notice of Intent in the *Federal Register* on November 21, 2018. In December 2018 and January and February 2019, the BLM held scoping meetings in the Alaska communities of Anchorage, Anaktuvuk Pass, Atqasuk, Fairbanks, Nuiqsut, Point Lay, Utqiaġvik, and Wainwright.. A digital recorder captured oral comments at all meetings. The BLM formally accepted scoping comments through February 15, 2019. For more information on the scoping process, see the final scoping report on the BLM's project website: https://www.blm.gov/planning-and-nepa/plans-in-development/alaska/npr-a-iap-eis.

The following summaries highlight a few of the issues identified during scoping and addressed in this IAP/EIS. The full list of summaries is available in the final scoping report.

- **Fish and wildlife**—Commenters stated concerns about impacts on fish and wildlife, including caribou and other large terrestrial mammals, marine mammals, migratory birds, and fish and other aquatic species. Potential impacts on the Teshekpuk Caribou Herd were of particular concern. Commenters requested that the IAP/EIS evaluate the use and importance of the Teshekpuk Lake area to herd movement during different life stages and seasons and how the proposed IAP/EIS might affect calving grounds, insect relief areas, and migration routes. Commenters expressed concern that the effects of increased infrastructure, aircraft noise, and marine traffic associated with post-leasing oil and gas development activities will cause behavioral changes in marine wildlife species, specifically walruses, whales, and seals. Additionally, commenters inquired about whether the BLM will implement current technologies for oil and gas exploration and other post-leasing development activities to mitigate impacts on migratory fish species.
- **Water resources**—Commenters requested that the IAP/EIS identify and protect all current and potential future drinking water sources, especially for tribal communities, including rivers. Commenters requested that the BLM consider the potentially significant effects of water use for oil and gas exploration and other post-leasing development activities on sensitive tundra streams and lakes in the NPR-A. This is because water withdrawals from tundra lakes can adversely affect tundra lake fish populations.
- **Special areas**—Commenters requested that the BLM retain current protections for all special areas in the planning area and prioritize maintaining the important values of all special areas already identified in the planning area. Several commenters requested that protections for special areas should be strengthened, and boundaries of special areas should be expanded. Commenters also requested that the IAP/EIS include a thorough analysis of any new scientific data that may allow portions of the current special areas to become open to lease sales.
- **Oil and gas**—Commenters requested that the IAP/EIS analysis consider direct, indirect, and cumulative impacts of all aspects of oil and gas exploration and development; examples given were access routes, support facilities, and other infrastructure needed for exploration and development and their potential future impacts.
- **Subsistence and sociocultural systems**—Commenters expressed concern that the proposed post-leasing oil and gas development activities could lead to unacceptable risks and impacts on surface and subsistence resources in the NPR-A, particularly around Teshekpuk Lake. They asked that the BLM consider the positive and negative economic changes to communities, impacts on the traditional subsistence-based economy, food scarcity, changes to access to traditional subsistence use areas, and subsistence food resources.
- **Economics**—Commenters requested the IAP/EIS analysis preparers consider the direct, indirect, and cumulative economic impacts of development in the NPR-A.

Issues outside the scope of the IAP/EIS were also identified during scoping. The BLM has considered these issues but has determined that they are inappropriate for analysis within this IAP/EIS. These include:

- Comments on issues that do not meet the stated purpose of and need for the IAP/EIS
- Comments about land management actions outside the BLM's jurisdiction

- Comments suggesting that the BLM halt onshore and offshore planning and permitting, postpone all timber sales, and stop all work on the Alaska-specific Roadless Rule

ALTERNATIVES

Alternative A—No Action Alternative

Alternative A would continue current management as approved in the February 2013 NPR-A IAP Record of Decision. Under Alternative A, approximately 52 percent (11.8 million acres) of the NPR-A's subsurface estate would be available for oil and gas leasing, including some lands closest to existing leases centered on the Greater Mooses Tooth and Bear Tooth units and Umiat. Lands near Teshekpuk Lake would continue to be unavailable for oil and gas leasing.

While providing these opportunities for oil and gas development, Alternative A would provide important protections for surface resources and other uses. Approximately 11 million acres would not be offered for oil and gas leasing under Alternative A, comprising a large majority of lands within special areas, and some Beaufort Sea waters in and near Dease Inlet and Utqiaġvik. This would protect crucial areas for sensitive bird populations and for the roughly 315,000 caribou found in the Teshekpuk and Western Arctic Caribou Herds. New infrastructure would be prohibited on 8.3 million acres.

Special areas under Alternative A include the Teshekpuk Lake Special Area, Colville River Special Area, Utukok River Uplands Special Area, Kasegaluk Lagoon Special Area, and Peard Bay Special Area. Special area designation does not itself impose specific protections, but instead highlights areas and resources for which the BLM will extend "maximum protection" consistent with exploration of the NPR-A. Alternative A would not recommend any rivers for addition to the Wild and Scenic Rivers system; however, the BLM would manage the existing 12 suitable rivers to protect their free flow, water quality, and outstandingly remarkable values.

Alternative B

Alternative B is similar to Alternative A, but it increases the land set aside for conservation, while allowing operators access for transporting oil from State offshore leases to the Trans-Alaska Pipeline System. The area available for leasing would decrease, compared with Alternative A, to 11.4 million acres (50 percent of the NPR-A's subsurface estate). This would be done to account for new resource-related data. The area closed to new infrastructure would increase to 10.5 million acres to prevent additional development in Teshekpuk Caribou Herd habitat and molting goose habitat.

In the Teshekpuk Lake Special Area, there would be two north-south pipeline corridors provided to allow for linear rights-of-way to transport oil and gas from offshore leases through areas otherwise closed to new infrastructure. This plan makes no decision regarding the exact location of such corridors, and potential corridors shown on maps are for representational purposes only. Specific corridor locations would be developed in subsequent NEPA analyses pursuant to K-6 and K-8 and Required Operating Procedure E-23 when a pipeline project is proposed. Under Alternative B, the 12 suitable rivers would be recommended for designation in the Wild and Scenic Rivers System.

Alternative C

Alternative C would increase the total number of acres available for leasing compared with Alternative A to 17.1 million acres (75 percent of NPR-A's subsurface estate). This would be accomplished by reducing the areas closed to leasing in the Teshekpuk Lake Special Area and within the Utukok River Uplands Special Area. The area closed to new infrastructure would decrease to 5.1 million acres, primarily by reducing the areas closed in the Utukok River Uplands Special Area. Both the Teshekpuk Lake Special Area and the

Utukok River Uplands Special Area would retain a core area that would be unavailable for leasing and closed to new infrastructure. Caribou calving habitat and other important biological resources would be protected from oil and gas development through no surface occupancy stipulations and timing limitations.

One north-south pipeline corridor east of Teshekpuk Lake would be provided in the Teshekpuk Lake Special Area. This would be done to allow for linear rights-of-way to transport oil and gas from offshore leases through areas otherwise closed to new infrastructure. This plan makes no decision regarding the exact location of such corridors, and potential corridors shown on maps are for representational purposes only. When a pipeline project is proposed, the specific corridor locations would be developed in subsequent NEPA analyses, pursuant to K-6 and K-8 and Required Operating Procedure E-23.

The southern and eastern portions of the Utukok River Uplands Special Area would be available for new infrastructure. Alternative C would not recommend any rivers for addition to the Wild and Scenic Rivers System, but under Alternative C, the BLM would manage the existing 12 suitable rivers to protect their free flow, water quality, and outstandingly remarkable values.

Alternative D

Alternative D would make the most land available for leasing (18.3 million acres, or 81 percent of NPR-A's subsurface estate) and the least land closed to new infrastructure (4.5 million acres). The management of the Utukok River Uplands, Kasegaluk Lagoon, and Peard Bay Special Areas would be the same as that under Alternative C. Under Alternative D, all of the Teshekpuk Lake Special Area would be available for leasing, with impacts on caribou calving habitat and important bird habitat partially mitigated through no surface occupancy stipulations and timing limitations. No pipeline corridors would be needed in the Teshekpuk Lake Special Area because more areas would be open to new infrastructure, including where pipelines may be needed to transport oil and gas from offshore leases (see **Appendix A**, **Map 2-8**).

As with Alternative C, no rivers would be recommended for addition to the Wild and Scenic Rivers System. The BLM would manage the existing 12 suitable rivers to protect their free flow, water quality, and outstandingly remarkable values.

The complete list of lease stipulations and required operating procedures under each alternative are presented in **Table 2-2** in **Chapter 2**.

HYPOTHETICAL DEVELOPMENT SCENARIOS

The BLM developed three hypothetical development scenarios for oil and gas exploration, development, production, and abandonment in the planning area under low, medium, and high development. The development scenarios are presented as entirely hypothetical development cases; they are not intended to be used for locations of impacts. Scenarios are unconstrained, which means the BLM developed them without consideration of existing or potential restrictions on development activities. Existing developments and those in the permitting process, such as the Willow development, are not included in the development or production projections below.

Low

Under a low development scenario, future development would occur only in the most promising areas and would connect to existing or planned infrastructure in the Willow development. Under this scenario, peak production from NPR-A developments could reach a maximum of 120,000 barrels of oil per day sometime in approximately the next 20 years, after which production is expected to decline at a rate of approximately 8 percent per year.

Assuming this development would construct two satellite pads, 30 miles of roads, 30 miles of elevated pipeline, one seawater treatment plant, and one barge landing, a total of 919 acres would be disturbed, and a total of 5,750,000 cubic yards of gravel would be required. These figures do not include disturbance from ice roads and pads or from gravel supply pits.

Medium

Under a medium development scenario, additional satellite developments would be added in the Bear Tooth Unit and connected to the Willow development central processing facility. A new central processing facility and development likely would be constructed in the area south or west of Teshekpuk Lake. Under this scenario, peak production from NPR-A developments could reach a maximum of 210,000 barrels of oil per day sometime in approximately the next 20 years, after which production is expected to decline at a rate of approximately 8 percent per year.

Assuming this development would construct one central processing facility, 10 satellite pads, 150 miles of roads, 150 miles of elevated pipeline, one seawater treatment plant, and one barge landing, a total of 1,360 acres would be disturbed, and a total of 8,400,000 cubic yards of gravel would be required. These figures do not include disturbance from ice roads and pads or from gravel supply pits.

High

Under a high development scenario, three central processing facilities and associated satellite pads would be constructed in the planning area, most likely at Smith Bay, south of Teshekpuk Lake, and north of Umiat, Alaska. Under this scenario, peak production from NPR-A developments could reach a maximum of 500,000 barrels of oil per day sometime in approximately the next 20 years, after which production is expected to decline at a rate of approximately 8 percent per year.

Assuming this development would construct three central processing facilities, 20 satellite pads, 250 miles of roads, 250 miles of elevated pipeline, two seawater treatment plants, and two barge landings, a total of 2,385 acres would be disturbed, and a total of 15,250,000 cubic yards of gravel would be required. These figures do not include disturbance from ice roads and pads or from gravel pits.

See **Appendix B** for more information on development potential, projections by alternative, assumptions behind potential estimates, and estimates for the baseline future hypothetical development scenario for petroleum.

IMPACT ANALYSIS

Issuance of oil and gas leases under the new IAP/EIS would have no direct impacts on the environment. This is because by itself a lease does not authorize any on-the-ground oil and gas activities; however, a lease does grant the lessee certain rights to drill for and extract oil and gas subject to further environmental review and reasonable regulation, including applicable laws, terms, conditions, and stipulations of the lease. The impacts of such future exploration and development activities that may occur because of the issuance of leases are considered potential indirect impacts of leasing. Such post-lease activities could include seismic surveys and exploratory drilling, development, and transportation of oil and gas in and from the NPR-A. Therefore, the analysis in **Chapter 3** is of potential direct, indirect, and cumulative impacts from on-the-ground, post-lease activities.

The geographic scope of the analysis includes marine vessel traffic from the shore of the NPR-A to Dutch Harbor, Alaska. Direct and indirect impacts cannot be analyzed on a site-specific basis within this IAP/EIS, but they are analyzed for the planning area generally, based on the reasonably foreseeable development scenario (**Appendix B**). Additional site-specific analyses would be conducted during the permit or authorization review process for subsequent exploration and development applications.

If leases were explored and developed, the BLM would expect the following general impacts from future oil and gas exploration, development, and production activities, including associated infrastructure:

- Potential impacts on subsistence users, both from impacts on subsistence species and from direct disturbance of hunts, displacement of resources from traditional harvest areas, and hunter avoidance of industrialized areas.
- Impacts on water quality, hydrology, and level caused by water extraction and construction of ice roads and pads, gravel mining, dust, and wastewater discharges from a central processing facility
- Impacts from routine activities on air quality due to release of pollutants
- Greenhouse gas emissions from exploration and development and downstream consumption of oil
- Potential impacts on birds from predators, increased human presence, and loss of habitat
- Potential impacts on fish and aquatic species from road and pads development, bridge and culvert construction, and gravel dust and spray
- Potential impacts on marine mammals, including human-polar bear interactions; vehicle, aircraft, and boat traffic and noise disturbance; and accidental, unplanned take by vessel strikes or oil spills
- Impacts on terrestrial mammals, including disturbance from vehicle and aircraft noise, human presence, and habitat fragmentation and loss
- Disturbance and loss of permafrost, vegetation, and wetlands
- Potential impacts on state employment, labor income, and revenues
- Potential impacts on North Slope Borough employment, income, revenue, and socioeconomics
- Potential impacts on cultural resources by lease development
- Visual impacts from infrastructure and artificial light
- Noise impacts from development and production activities

Most sociocultural effects would affect communities in the NPR-A—Atqasuk, Nuiqsut, Utqiaġvik, and Wainwright, for example in a planning area-wide context; nevertheless, a number of sociocultural effects could extend beyond the NPR-A to other North Slope communities (Point Lay and Anaktuvuk Pass) or, in some instances, to subsistence users from other regions (i.e., regional context).

COLLABORATION AND COORDINATION

The BLM is the lead agency for this IAP/EIS. The following are participating in the NPR-A IAP/EIS as cooperating agencies: the Bureau of Ocean Energy Management, Iñupiat Community of the Arctic Slope, National Park Service, North Slope Borough, State of Alaska, and U.S. Fish and Wildlife Service. The BLM requested their participation because of their expertise; their participation does not constitute their approval of the analysis, conclusions, or alternatives presented in this IAP/EIS; the BLM is solely responsible for these. **Appendix C** includes the list of preparers for the IAP/EIS.

Tribes, ANCSA Corporations, and North Slope Communities

The BLM, as the lead federal agency, consulted with federally recognized tribal governments during preparation of this IAP/EIS and identified seven tribes that could be substantially affected by the IAP/EIS. Consistent with the Department of the Interior policy on government-to-government consultation with tribes, the BLM first sent a letter of notification and inquiry on November 8, 2018, to the federally recognized tribes in the communities of Anaktuvuk Pass, Atqasuk, Nuiqsut, Point Lay, Utqiaġvik, and Wainwright and to the Iñupiat Community of the Arctic Slope. In its letter, the BLM informed these entities of the upcoming IAP/EIS and offered the opportunity to participate in formal government-to-government consultations, to consult on cultural resources pursuant to Section 106 of the National Historic Preservation Act, or to simply receive information about the project. **Appendix C** provides the dates and locations of government-to-government meetings that have taken place. Discussions with potentially affected tribal governments will take place throughout the IAP/EIS process.

In November 2018, the BLM also sent letters to the North Slope Subsistence Resource Advisory Council and the 32 representatives that make up the Western Arctic Caribou Herd Working Group, inviting them to consult on the new IAP/EIS.

On November 8, 2018, the BLM also sent a letter of notification to the Arctic Slope Regional Corporation and the village corporations for the communities of Anaktuvuk Pass, Atqasuk, Nuiqsut, Point Lay, Utqiaġvik, and Wainwright. In this letter, the BLM offered the opportunity to participate in formal ANCSA corporation consultation on the IAP/EIS. The BLM has held consultations with the Arctic Slope Regional Corporation and the Kuukpik Corporation to discuss the IAP/EIS process (see **Appendix C**).

Consultation Pursuant to Federal Law

In accordance with Section 106 of the National Historic Preservation Act, the BLM is consulting with the Alaska State Historic Preservation Officer to determine how proposed activities could affect cultural resources listed on or eligible for listing on the National Register of Historic Places. Formal consultations with the State Historic Preservation Office may be required when individual projects are implemented. The State Historic Preservation Office may provide technical review or assistance on the NPR-A IAP/EIS but declined to consult with the BLM; the State Historic Preservation Office acknowledged that the NPR-A IAP/EIS, as a land use plan, is an administrative action without the potential to affect historic properties.

To comply with Section 7(a)(2) of the Endangered Species Act, the BLM began consulting with the U.S. Fish and Wildlife Service and National Marine Fisheries Service early in the IAP/EIS process. Those agencies provided input on issues, data collection and review, and alternatives development. The BLM is consulting with them and is developing biological assessments with each agency.

Consultation with Working Groups

NPR-A Working Group: The NPR-A Working Group was established in the 2013 NPR-A IAP Record of Decision and includes city, tribal, and ANCSA corporation representatives of all North Slope communities. The BLM has held five meetings to consult with the NPR-A Working Group on the new IAP/EIS.

Western Arctic Caribou Herd Working Group: The Western Arctic Caribou Herd Working Group is a group comprised of community representatives from every community that subsists from the Western Arctic Caribou Herd. The BLM consulted with the Working Group in Anchorage on December 13, 2018 and will be updating the group at a December 2019 meeting.

ANILCA SECTION 810 EVALUATION

Section 810 of the Alaska National Interest Lands Conservation Act focuses on issues related to the effects of proposed activities on subsistence use. An Alaska National Interest Lands Conservation Act Section 810 notice and public hearing process is required if a proposed action may significantly restrict subsistence uses and needs. **Appendix E** provides a preliminary evaluation and proposed finding of effects on subsistence uses and needs from actions that could be undertaken under the four alternatives and the cumulative case considered in this IAP/EIS. The preliminary evaluation concluded that subsistence uses and needs may be significantly restricted for the community of Nuiqsut under Alternatives A, B, and C, and for the communities of Anaktuvuk Pass, Atqasuk, Nuiqsut, Utqiagvik and Wainwright under Alternative D. The preliminary evaluation of the alternatives and the cumulative case concluded that subsistence uses and needs may be significantly restricted for the communities of Nuiqsut, Point Lay, Utqiagvik and Wainwright under Alternatives A, B, and C, and for the communities of Anaktuvuk Pass, Atqasuk, Nuiqsut, Point Lay, Utqiagvik and Wainwright under Alternative D. For more information, see **Appendix E**.

TRADITIONAL KNOWLEDGE REVIEW

The BLM requested that traditional knowledge be considered during the NPR-A IAP/EIS preparation. It contracted with Stephen R. Braund & Associates to review sources of traditional knowledge and to compile the information into a report. Stephen R. Braund & Associates compiled the available traditional knowledge relevant to the NPR-A into a report. It came from 80 sources that had been documented in the six North Slope communities of Anaktuvuk Pass, Atqasuk, Nuiqsut, Point Lay, Utqiaġvik, and Wainwright since 1976. The complete report can be found in **Appendix Y**. The focus was on traditional knowledge applicable to the nature of development and relevant to impacts and mitigation associated with the IAP or that contained traditional knowledge about the environment in and around the NPR-A. Local observations and information from residents provided their physical, biological, and social environment experiences.

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Chapter 1. Introduction

1.1 OVERVIEW

In accordance with the Naval Petroleum Reserves Production Act of 1976, as amended, the Bureau of Land Management (BLM) Alaska State Office, Anchorage, Alaska, has prepared a new Integrated Activity Plan and Environmental Impact Statement (IAP/EIS) for BLM-managed lands within the National Petroleum Reserve in Alaska (NPR-A). The Naval Petroleum Reserves Production Act (42 United States Code [USC] 6501), as amended, excludes the NPR–A from the application of Section 202 of the Federal Land Policy and Management Act (43 USC 1701), as amended, which is the basis for the BLM's resource management plans. The BLM conducts planning within the NPR-A with an IAP. The BLM complies with all applicable laws in the preparation of the IAP, including the National Environmental Policy Act of 1970 (NEPA), Endangered Species Act of 1973, Marine Mammal Protection Act of 1972, and National Historic Preservation Act of 1966.

1.2 PURPOSE AND NEED

The BLM is undertaking a revision to the NPR-A IAP/EIS to determine the appropriate management of all BLM-managed lands in the NPR-A in a manner consistent with existing statutory direction and Secretarial Order 3352. Secretarial Order 3352 directed the development of a schedule to "effectuate the lawful review and development of a revised IAP for the NPR-A that strikes an appropriate balance of promoting development while protecting surface resources." The Naval Petroleum Reserves Production Act, as amended, and its implementing regulations require oil and gas leasing in the NPR-A and the protection of surface values consistent with exploration, development, and transportation of oil and gas.

1.3 DECISIONS TO BE MADE

This revised IAP/EIS includes consideration of a range of leasing alternatives that make lands available for leasing, examination of current special area boundaries, and consideration of new or revised lease stipulations and required operating procedures. The IAP/EIS would ensure that the BLM's land management will provide the opportunity, subject to appropriate conditions developed through a NEPA process, to construct pipelines and other necessary infrastructure to bring oil and gas resources from offshore or adjacent leases to the Trans-Alaska Pipeline System or a future gas pipeline from the North Slope. The IAP/EIS would also consider the potential for a road or other transportation system connecting communities across the North Slope. This plan will supersede the 2013 NPR-A IAP Record of Decision (ROD), and depending on the alternative selected, may supersede the 2008 Colville River Special Area Management Plan, as amended by the 2013 update. The decisions evaluated in this IAP/EIS and its ROD would authorize lease sales, but would not authorize any on-the-ground activity associated with the exploration or development of oil and gas resources, or other land uses, in the NPR-A.

1.4 PLANNING AREA

The planning area includes all lands and only such lands as are managed by the BLM in the NPR-A (see **Map 1-1** in **Appendix A**). The decision area includes only the surface land and subsurface mineral estate in the planning area over which the BLM has authority to make land use and management decisions. These BLM-managed lands total approximately 22.5 million acres of surface and subsurface estate. Nearly 234,000 additional acres of subsurface estate are under the Alaska Native Claims Settlement Act (ANCSA) village corporation surface estate (see **Table 1-1** and **Maps 1-2** and **1-3** in **Appendix A**).

Table 1-1
Decision Area

Lands Affected by this Plan	Acres
Federal surface estate and federal subsurface estate	22,520,000
Federal subsurface estate with nonfederal surface estate	234,000
Total	**22,754,000**

Source: BLM GIS 2019
Note: Acreages are rounded up or down to the nearest 100 acres.

The IAP/EIS does not make decisions about:

- Surface or subsurface estates owned by ANCSA regional or village corporations
- The subsurface oil and natural gas estate of the North Slope Borough near Utqiaġvik
- Lands retained by the U.S. Navy near Point Barrow (Tract #1)
- The surface lands within (a) certified Native allotments owned by private individuals, (b) the airstrip at Umiat (owned by the State of Alaska), and (c) lands owned by the North Slope Borough near Cape Simpson

The boundary of the NPR-A is as described in Executive Order 3797-A of February 27, 1923. The northern portion of the eastern boundary of the NPR-A is along the western bank of the Colville River. That boundary is defined in Executive Order 3797-A as the "highest highwater mark…on the [western] bank," which the U.S. District Court for the District of Alaska construed to be "on and along the bank at the highest level attained by the waters of the river when they reach and wash the bank without overflowing it" (*Alaska v. U.S.*; case no. A78-069 Civ. December 7, 1984). Thus, neither the Colville River nor its banks immediately adjacent to the river downstream from approximately longitude 156°08′ are in the NPR-A.

The southern part of the eastern boundary of the NPR-A is a line at approximately longitude 156°08′ from the Colville River south to the crest of the Brooks Range. The southern boundary of the NPR-A lies along the top of the Brooks Range to approximately longitude 161°46′, which composes the NPR-A's western boundary from the Brooks Range to the Chukchi Sea. The northern NPR-A boundary encompasses the bays, lagoons, inlets, and tidal waters between the NPR-A's outlying islands and the mainland, thus accounting for over 429,000 acres of submerged estate within the NPR-A. The U.S. Supreme Court (in *U.S. v. Alaska*; No. 84, Orig. decided on June 19, 1997) determined that the NPR-A included these tidally influenced waters and that those waters and the submerged lands underlying them did not transfer to the State of Alaska at statehood.

1.5 SCOPING AND ISSUES

The BLM conducted formal scoping for the NPR-A IAP/EIS following publication of a Notice of Intent in the *Federal Register* on November 21, 2018. In December 2018 and January and February 2019, the BLM held scoping meetings in the Alaskan communities of Anchorage, Anaktuvuk Pass, Atqasuk, Fairbanks, Nuiqsut, Point Lay, Utqiaġvik, , and Wainwright. A digital recorder captured oral comments at all meetings. The BLM formally accepted scoping comments through February 15, 2019. For more information on the scoping process, see the final scoping report on the BLM's project website: https://www.blm.gov/planning-and-nepa/plans-in-development/alaska/npr-a-iap-eis.

The following summaries highlight a few of the issues identified during scoping and addressed in this IAP/EIS. The full list of summaries is available in the final scoping report.

- **Fish and wildlife**—Commenters stated concerns about impacts on fish and wildlife, including caribou and other large terrestrial mammals, marine mammals, migratory birds, and fish and other aquatic species. Potential impacts on the Teshekpuk Caribou Herd were of particular concern. Commenters requested that the IAP/EIS evaluate the use and importance of the Teshekpuk Lake area to herd movement during different life stages and seasons and how the proposed IAP/EIS might affect calving grounds, insect relief areas, and migration routes. Commenters expressed concern that the effects of increased infrastructure, aircraft noise, and marine traffic associated with post-leasing oil and gas development activities will cause behavioral changes in marine wildlife species, specifically walruses, whales, and seals. Additionally, commenters inquired about whether the BLM will implement current technologies for oil and gas exploration and other post-leasing development activities to mitigate impacts on migratory fish species.
- **Water resources**—Commenters requested that the IAP/EIS identify and protect all current and potential future drinking water sources, especially for tribal communities, including rivers. Commenters requested that the BLM consider the potentially significant effects of water use for oil and gas exploration and other post-leasing development activities on sensitive tundra streams and lakes in the NPR-A. This is because water withdrawals from tundra lakes can adversely affect tundra lake fish populations.
- **Special areas**—Commenters requested that the BLM retain current protections for all special areas in the planning area and prioritize maintaining the important values of all special areas already identified in the planning area. Several commenters requested that protections for special areas should be strengthened, and boundaries of special areas should be expanded. Commenters also requested that the IAP/EIS include a thorough analysis of any new scientific data that may allow portions of the current special areas to become open to lease sales.
- **Oil and gas**—Commenters requested that the IAP/EIS analysis consider direct, indirect, and cumulative impacts of all aspects of oil and gas exploration and development; examples given were access routes, support facilities, and other infrastructure needed for exploration and development and their potential future impacts.
- **Subsistence and sociocultural systems**—Commenters expressed concern that the proposed post-leasing oil and gas development activities could lead to unacceptable risks and impacts on surface and subsistence resources in the NPR-A, particularly around Teshekpuk Lake. They asked that the BLM consider the positive and negative economic changes to communities, impacts on the traditional subsistence-based economy, food scarcity, changes to access to traditional subsistence use areas, and subsistence food resources.
- **Economics**—Commenters requested the IAP/EIS analysis consider the direct, indirect, and cumulative economic impacts of development in the NPR-A.

Issues outside the scope of the IAP/EIS were also identified during scoping. The BLM has considered these issues but has determined they are inappropriate for analysis within this IAP/EIS. These include:

- Comments on issues that do not meet the stated purpose of and need for the IAP/EIS
- Comments about land management actions outside the BLM's jurisdiction

- Comments suggesting that the BLM halt onshore and offshore planning and permitting, postpone all timber sales, and stop all work on the Alaska-specific Roadless Rule

1.6 LEGISLATIVE CONSTRAINTS

The BLM undertakes this plan in accordance with its responsibilities to manage the NPR-A under the authority and direction of the Naval Petroleum Reserves Production Act and Federal Land Policy and Management Act. The NPR-A IAP/EIS addresses these responsibilities through a NEPA-required process (i.e., an EIS).

Under the Naval Petroleum Reserves Production Act, the Secretary is required to conduct oil and gas leasing and development in the NPR-A (42 USC 6506a). The Department of the Interior and Related Agencies' Fiscal Year 1981 Appropriations Act specifically directs the Secretary to undertake "an expeditious program of competitive leasing of oil and gas" in the Petroleum Reserve. The Naval Petroleum Reserves Production Act provides that the Secretary "shall assume all responsibilities" for "any activities related to the protection of environmental, fish and wildlife, and historical or scenic values" (42 USC § 6503(b)) and authorizes the Secretary to "promulgate such rules and regulations as he deems necessary and appropriate for the protection of such values within the Reserve." The Naval Petroleum Reserves Production Act's implementing regulations are found at 43 Code of Federal Regulations (CFR) 2360.

The Department of the Interior and Related Agencies' Fiscal Year 1981 Appropriations Act exempted the NPR-A from Sections 202 and 603 of Federal Land Policy and Management Act. Section 202 (43 USC 1712) requires the preparation of land use plans (called resource management plans, in regulations—43 CFR 1600—adopted by the BLM). Because of the exemption from Federal Land Policy and Management Act section 202, this plan is not being developed as a resource management plan. While the IAP analyzes a range of possible future BLM management practices for NPR-A in a manner similar to that done in a resource management plan, it is conducted consistent with NEPA regulations—40 CFR 1500–1508—rather than Federal Land Policy and Management Act regulations. And, consistent with the Naval Petroleum Reserves Production Act, the NPR-A IAP/EIS addresses a narrower range of multiple use management than a resource management plan (e.g., it makes no decisions on opening lands to hard rock or coal mining). Section 603 of Federal Land Policy and Management Act (43 USC 1782) requires a study of BLM-managed lands under Section 3(d) of the Wilderness Act. In accordance with the exemption from Section 603 of Federal Land Policy and Management Act, this plan does not contain such a wilderness study.

Under the Federal Land Policy and Management Act, the Secretary has broad authority to regulate the use, occupancy, and development of public lands and to take whatever action is required to prevent unnecessary or undue degradation of the public lands (43 USC 1732). Each of the alternatives described in **Chapter 2**, consistent with the Naval Petroleum Reserves Production Act and the mandates of 40 CFR 1502.14, presents a different approach to such regulation of the public lands and presents different approaches to prevent unnecessary and undue degradation.

For a summary of other applicable federal, state, and local laws and regulations, as well as international agreements, refer to **Appendix D**. The BLM will continue to consult with regulatory agencies, as appropriate, during the NEPA process and before activities are authorized, to ensure that all requirements are met.

1.7 PLANNING PROCESS

The NPR-A IAP/EIS process began with the Notice of Intent to prepare the IAP/EIS, followed by the formal scoping period (see **Section 1.5**). After the scoping period and after receiving additional input from the public, the BLM consulted with the cooperating agencies, tribes, and ANCSA corporations; researched information on the resources and uses of the area; developed a range of reasonable management alternatives; and analyzed the impacts of those alternatives. These analyses underwent review within the BLM and among the cooperating agencies, resulting in this draft IAP/EIS. This is the second major public step in the EIS process.

The public and agencies will be able to comment on this document. Based on these comments and any new studies or information that may come to light after publication of the draft IAP/EIS, the BLM will revise the document and issue a final IAP/EIS. The BLM will not issue its decision on the leasing program, called the ROD, until at least 30 days after the Environmental Protection Agency publishes the Notice of Availability of the final IAP/EIS in the *Federal Register*.

1.8 REQUIREMENTS FOR FURTHER ANALYSIS

NEPA documentation is required before the BLM can authorize actions that affect the environment. Actions that could individually or cumulatively have a significant effect on the environment would be authorized only after completion of an EIS. Actions that are not anticipated to have a significant effect on the environment could be authorized after completion of an environmental assessment. Actions having no new significant effects could be analyzed in an environmental assessment tiered to an existing EIS, including this IAP/EIS once it is finalized. Actions that have been shown not to have the potential for individual or cumulative significant impacts can be authorized using categorical exclusions.

The decision regarding oil and gas leasing resulting from this plan may authorize multiple lease sales. The first lease sale based on this plan and associated ROD most likely would occur in 2020, with subsequent annual lease sales. For impact analysis purposes, this plan assumes that all lands that the ROD determines to be available for leasing would be offered in the first and subsequent lease sales, though lands with the proposed 10-year deferral (Alternative B) would not be offered until after the deferral expires.

Readers should bear in mind, however, that the first sale, and any subsequent sale, might offer only a portion of the lands identified in the ROD as available, making possible a phased approach to leasing and development. The area offered in the first sale would be within the area identified in this plan's ROD as available and not deferred for leasing. The timing of and the lands offered for lease in the second and subsequent sales, if any, would depend in part on the response to the first sale and the results of the exploration that follows.

This IAP/EIS is intended to fulfill NEPA requirements for lease sales conducted at least through December 2039 and potentially thereafter. Before it conducts the second and each subsequent lease sale, the BLM will evaluate the adequacy of the IAP/EIS in light of new information and circumstances to determine whether it requires supplementation or revision in order to comply with NEPA.

Future on-the-ground actions requiring BLM approval, including potential exploration and development proposals, would require further NEPA analysis based on the site-specific proposal. Applicants would be subject to the terms of the lease, including lease stipulations in effect at the time the lease is issued or renewed and required operating procedures adopted in the ROD for this IAP/EIS; however, the BLM Authorized Officer may require additional site-specific terms and conditions before authorizing any oil and gas activity based on the project-level NEPA analysis.

1.9 ANILCA SECTION 810 EVALUATION

Section 810 of the Alaska National Interest Lands Conservation Act focuses on issues related to the effects of proposed activities on subsistence use. An Alaska National Interest Lands Conservation Act Section 810 notice and public hearing process is required if a proposed action may significantly restrict subsistence uses and needs. **Appendix E** provides a preliminary evaluation and proposed finding of effects on subsistence uses and needs from actions that could be undertaken under the four alternatives and the cumulative case considered in this IAP/EIS. The preliminary evaluation concluded that subsistence uses and needs may be significantly restricted for the community of Nuiqsut under Alternatives A, B, and C, and for the communities of Anaktuvuk Pass, Atqasuk, Nuiqsut, Utqiagvik and Wainwright under Alternative D. The preliminary evaluation of the alternatives and the cumulative case concluded that subsistence uses and needs may be significantly restricted for the communities of Nuiqsut, Point Lay, Utqiagvik and Wainwright under Alternatives A, B, and C, and for the communities of Anaktuvuk Pass, Atqasuk, Nuiqsut, Point Lay, Utqiagvik and Wainwright under Alternative D. For more information, see **Appendix E**.

Chapter 2. Alternatives

2.1 INTRODUCTION

The alternatives presented in this chapter address the public's concerns, particularly those comments expressed during the formal scoping period, as well as those raised through consultation with North Slope Inupiaq tribal governments and Alaska Native Claims Settlement Act (ANCSA) corporations, and cooperating agencies. The range of alternatives presented in this chapter was developed by the Bureau of Land Management (BLM) Alaska, in coordination with the cooperating agencies. The alternatives respond to the purpose and need for action, including existing statutory direction and Secretarial Order 3352 directing the development of a schedule to "effectuate the lawful review and development of a revised Integrated Activity Plan (IAP) for the National Petroleum Reserve in Alaska (NPR-A) that strikes an appropriate balance of promoting development while protecting surface resources."

The alternatives have benefitted from the insights and expertise of the cooperating agencies, though those agencies are not responsible for the range of alternatives examined in this IAP/environmental impact statement (EIS) (see **Section 1.8.1** for a list of the cooperating agencies); the BLM as the lead agency is solely responsible for the alternatives.

The action alternatives (Alternatives B, C, and D) described in **Section 2.2** include a mix of lease stipulations and required operating procedures (ROPs). They contain measures to avoid or mitigate adverse impacts on surface resources and other uses, such as subsistence, recreation, scientific study, and others, throughout the planning area.

The BLM is analyzing this range of alternatives to ensure that a wide spectrum of management options is considered, consistent with applicable law, and that the options address public scoping suggestions and agency concerns for protecting resources and uses. Any decision that the BLM makes following the analysis done through this IAP/EIS must be consistent with the Naval Petroleum Reserves Production Act and with other applicable laws and regulations.

2.2 DESCRIPTION OF THE ALTERNATIVES

Table 2-1 highlights the key differences among alternatives relative to major land allocations. Maps in **Appendix A** depict the major land allocations. **Table 2-2** (below) is a complete description of all lease stipulations, ROPs, and lease notices that would apply under each alternative.

Table 2-1
Quantitative Summary of Alternatives

Land Allocations	Alt. A	Alt. B	Alt. C	Alt. D
Total acreage available for leasing	11,763,000	11,420,000	17,053,000	18,324,000
Total acreage unavailable for leasing	10,991,000	11,334,000	5,701,000	4,430,000
Closed to fluid mineral leasing	10,991,000	11,334,000	5,701,000	4,430,000
Open to fluid mineral leasing	—	—	—	—
Subject to no surface occupancy	2,489,000	3,791,000	5,013,000	4,653,000
Subject to controlled surface use	0	0	0	439,000
Subject to timing limitation	0	0	622,000	1,162,000
Subject to only standard terms and conditions	9,274,000	7,629,000	11,418,000	12,070,000

Land Allocations	Alt. A	Alt. B	Alt. C	Alt. D
Lease deferral around Nuiqsut	0	708,000	0	0
Unavailable for new infrastructure	8,312,000	10,537,000	5,133,000	4,531,000
Unavailable, except for essential pipeline crossings	443,000	423,000	443,000	619,000
Unavailable, except for essential road and pipeline crossings	2,691,000	3,167,000	3,132,000	3,140,000
Unavailable, except for essential coastal infrastructure	259,000	110,000	271,000	300,000
Available for new infrastructure	10,815,000	8,094,000	13,468,000	13,930,000
Pipeline corridor	0	189,000	73,000	0
Sand and gravel mining prohibited (mineral materials disposal)	0	61,000	61,000	61,000
Sand and gravel mining (mineral materials disposal) authorized on a case-by-case basis	22,754,000	22,693,000	22,693,000	22,693,000
Teshekpuk Lake Special Area	3,642,000	3,465,000	3,465,000	3,465,000
Colville River Special Area	2,441,000	0	0	0
Utukok River Uplands Special Area	7,058,000	7,058,000	7,058,000	7,058,000
Kasegaluk Lagoon Special Area	96,000	96,000	96,000	96,000
Peard Bay Special Area	106,000	106,000	106,000	106,000
Visual resource management class II	8,353,000	14,237,000	8,979,000	8,566,000
Visual Resource Management class III	5,805,000	432,000	1,420,000	1,420,000
Visual Resource Management class IV	8,362,000	7,851,000	12,121,000	12,543,000
Suitable Wild and Scenic River segments recommended for designation	0	342,000	0	0

2.2.1 Features Common to All Alternatives

The sections below describe actions that are common to multiple alternatives. Features common to all alternatives would apply under Alternatives A, B, C, and D. Features common to all action alternatives would apply under Alternatives B, C, and D.

Oil and Gas Leasing

Alternatives in this IAP/EIS would apply stipulations to oil and gas leases to protect sensitive resources and other uses. These stipulations may include no surface occupancy, controlled surface use, and timing limitations.

No surface occupancy stipulations applied to an area mean that area is open to fluid mineral leasing, but surface occupancy and surface-disturbing activities associated with fluid mineral leasing are prohibited. Access to leased federal fluid mineral deposits would require directional or horizontal drilling from outside the boundaries of the no surface occupancy area. Applying controlled surface use stipulations to an area allows some use and occupancy of the surface, but special operational constraints are imposed to protect identified resources and other uses. A timing limitation prohibits surface use during specified periods to protect identified resources and other uses.

Existing leases would not be affected by the stipulations or closures considered in the alternatives for this IAP/EIS; they would remain subject to the stipulations in place when the lease was issued; however, if a lease is renewed for an additional 10-year term under 43 Code of Federal Regulations (CFR) 3135.1-6, the lease stipulations in the IAP that are in effect on the date that the BLM approves such a renewal would replace the original lease stipulations. If an alternative would close an area to leasing that is already leased the existing leases could continue to be developed or renewed; however, if the leases were to expire, the tracts would not be available for re-lease.

Infrastructure

Throughout the following description of alternatives, the term infrastructure refers to permanent structures and does not include subsistence camps and cabins, single season ice infrastructure, or exploration wells that are drilled, plugged, and abandoned in the same winter. Where areas are closed to new infrastructure, those closures do not apply to the structures described in the previous sentence. Additionally, constructing, renovating, or replacing facilities on existing disturbed sites may be permitted if the facilities would promote safety or environmental protection.

All alternatives allow for applications to construct permanent onshore oil and gas infrastructure to support lease development in both the NPR-A and adjacent areas. This includes infrastructure, such as pipelines, necessary for owners of offshore state and federal leases to bring oil and gas across NPR-A to the Trans-Alaska Pipeline System. Locations of infrastructure would be limited by infrastructure and corridor management prescriptions contained in lease stipulations and ROPs under the specific alternative.

Under all action alternatives, community infrastructure projects may be permitted, with appropriate mitigation measures, in areas closed to oil and gas leasing and development or subject to no surface occupancy stipulations on oil and gas leases. A community infrastructure project is defined as an infrastructure project that responds to community needs, such as roads, power lines, fuel pipelines, and communications systems, and is owned and maintained by the North Slope Borough (NSB), city government, the State of Alaska, a tribe, or an ANCSA corporation. For example, all action alternatives would allow for a potential community road connecting Nuiqsut and Utqiaġvik that is routed north of Teshekpuk Lake.

Special Area Boundaries

All action alternatives include the following Special Areas with the same boundaries and acreage: Utukok River Uplands, Kasegaluk Lagoon, and Peard Bay. In accordance with Section 104(b) of the Naval Petroleum Reserves Production Act (42 U.S. Code (USC) 6504(a)), special area boundaries reflect those areas containing significant subsistence, recreational, fish and wildlife, or historic or scenic values. In such areas, unique management prescriptions are necessary to ensure maximum protection of the values, consistent with the requirements for exploration of the Reserve. Given that the identification of areas where such significant values exist is a fact-based inventory determination, the special area boundaries do not vary among the action alternatives.

Special area designation implies the need for additional, unique management prescriptions beyond the base level stipulations and ROPs that apply throughout the entire NPR-A; however, designation itself does not impose specific management prescriptions on exploration and development. In areas where a significant value does not require unique management prescriptions, such as where the base level stipulations and ROPs throughout the NPR-A ensure protection for the value, special area designation is not warranted. Land management prescriptions in the special areas differ by alternative.

Colville River Special Area

While the Colville River Special Area is currently designated under Alternative A, it is not carried forward under the action alternatives. Under all action alternatives the base level ROPs are adequate to protect raptor habitat throughout the entire Reserve, and no special management is required in the Colville River Special Area to ensure adequate protections for raptors (see K-1 and ROPs A-8, C-2, E-8, E-16, E-21, E-22, and F-3).

Under all action alternatives, the base level ROPs include all but one of the special management protections that apply in the current Colville River Special Area under Alternative A. They extend these maximum protections for raptors and raptor habitat throughout the entire Reserve. The one exception, K-12 under Alternative A, contains requirements to locate facilities as far from raptor nests "as feasible" and to avoid altering "high quality" raptor foraging habitat within 15 miles of raptor nests.

In light of its experience attempting to implement this vague provision, the BLM has deemed it unenforceable, due to the practical inability to discern how far from nests it is still feasible to construct facilities or to determine which foraging habitat is high quality; however, other stipulations and ROPs, such as those imposing buffers around waterbodies, also protect raptor foraging habitat. Since the current Colville River Special Area's raptor protections are extended throughout the entire NPR-A under all action alternatives, no unique management prescriptions apply in the area, and thus special area designation is not warranted.

Teshekpuk Lake Special Area

Under Alternative A, the Teshekpuk Lake Special Area boundary would be the same as that from the 2013 Record of Decision (ROD). A different boundary applies under the action alternatives because of changes in the calving distribution of the Teshekpuk Caribou Herd (TCH) since the 2013 ROD was adopted, expanding the western boundary (see **Appendix A**, **Map 2-18**). The southern boundary was moved north because protections for yellow-billed loons outlined in ROP E-11 apply across the entire Reserve, so no unique management prescriptions for yellow-billed loons apply in the Teshekpuk Lake Special Area.

Wildland Fire Management

Under all alternatives, the BLM would manage the Reserve to protect human life, property, and resource values from wildfires. This may include both suppression actions and allowing natural fires to burn. Fire retardants and heavy equipment would be used in fire suppression in the NPR-A only at the direction of the BLM Authorized Officer (AO).

Management of Rivers Suitable for Wild and Scenic River Designation

There are 12 rivers in the NPR-A that have been determined to be suitable for designation as part of the National Wild and Scenic Rivers system. Under all alternatives, the BLM would manage the 12 suitable rivers to protect their free flow, water quality, and outstandingly remarkable qualities. All 12 suitable rivers would be recommended for Wild and Scenic River designation under Alternative B, but no rivers would be recommended under any other alternatives.

River Buffers

Under all alternatives, all major rivers in the NPR-A have 0.5 to 7-mile-wide buffers. Within these buffers, permittees could construct essential pipeline and roads that cross the river, but no other permanent infrastructure would be permitted.

Management of the Peard Bay and Kasegaluk Lagoon Special Areas and Wainwright Inlet/Kuk River

There would be no change in management of the Peard Bay and Kasegaluk Lagoon Special Areas and Wainwright Inlet/Kuk River. These areas would remain closed to leasing under all alternatives. Sand and gravel mining would be authorized on a case-by-case basis. New infrastructure may be allowed to support offshore oil and gas development or community needs.

Sand and Gravel

Under Alternative A, the BLM would continue to allow sand and gravel mining (mineral materials disposal) on a case-by-case basis throughout the entire decision area. This is also true under all action alternatives, with the exception of the Fish Creek 3-mile setback downstream of the eastern edge of Section 31, T11N, R1E, Umiat Meridian (U.M.). The Fish Creek setback would be closed to sand and gravel mining under all action alternatives (see **Appendix A**, **Map 2-17**).

2.2.2 Alternative A—No Action Alternative

Alternative A would continue current management approved in the February 2013 NPR-A IAP ROD. Under Alternative A, approximately 52 percent (11.8 million acres) of the NPR-A's subsurface estate would be available for oil and gas leasing, including some lands closest to existing leases centered on the Greater Mooses Tooth and Bear Tooth units and Umiat. Lands near Teshekpuk Lake would continue to be unavailable for oil and gas leasing.

While providing these opportunities for oil and gas development, Alternative A would provide important protections for surface resources and other uses. Approximately 11 million acres would not be offered for oil and gas leasing under Alternative A, comprising most lands in special areas and some Beaufort Sea waters in and near Dease Inlet and Utqiaġvik. This would protect crucial areas for sensitive bird populations and for the roughly 315,000 caribou found in the Teshekpuk and Western Arctic Caribou Herds. New infrastructure would be prohibited on 8.3 million acres.

Special areas under Alternative A are the Teshekpuk Lake Special Area, Colville River Special Area, Utukok River Uplands Special Area, Kasegaluk Lagoon Special Area, and Peard Bay Special Area. Alternative A would not recommend any rivers for addition to the Wild and Scenic Rivers system; however the BLM would manage the existing 12 suitable rivers to protect their free flow, water quality, and outstandingly remarkable values.

2.2.3 Alternative B

Alternative B is similar to Alternative A, but it increases the land set aside for conservation, while allowing access for operators to transport oil from State offshore leases to the TAPS. The area available for leasing would decrease compared to Alternative A to 11.4 million acres (50 percent of the NPR-A's subsurface estate) to account for new resource-related data. The area closed to new infrastructure would increase to 10.5 million acres to prevent additional development in TCH habitat and molting goose habitat.

In the Teshekpuk Lake Special Area, there would be two north-south pipeline corridors provided to allow for linear rights-of-way to transport oil and gas from offshore leases through areas otherwise closed to new infrastructure. This alternative makes no decision regarding the exact location of such corridors, and potential corridors shown on maps are for representational purposes only. Specific corridor locations would be developed in subsequent National Environmental Policy Act (NEPA) analyses, pursuant to K-6 and K-8 and ROP E-23, when a pipeline project is proposed. Alternative B recommends the 12 suitable rivers for designation in the Wild and Scenic Rivers system.

2.2.4 Alternative C

Alternative C would increase the total number of acres available for leasing, compared with Alternative A to 17.1 million acres (75 percent of NPR-A's subsurface estate). This would be accomplished by reducing the areas closed to leasing in the Teshekpuk Lake Special Area and in the Utukok River Uplands Special Area. The area closed to new infrastructure would decrease to 5.1 million acres, primarily by reducing the areas closed in the Utukok River Uplands Special Area. Both the Teshekpuk Lake Special Area and the Utukok

River Uplands Special Area would retain a core area that would be unavailable for leasing and closed to new infrastructure.

Caribou calving habitat and other important biological resources would be protected from oil and gas development through no surface occupancy stipulations and timing limitations. One north-south pipeline corridor east of Teshekpuk Lake would be provided in the Teshekpuk Lake Special Area to allow for linear rights-of-way to transport oil and gas from offshore leases through areas otherwise closed to new infrastructure. This alternative makes no decision regarding the exact location of such corridors, and potential corridors shown on maps are for representational purposes only. The specific corridor location would be developed in subsequent NEPA analyses, pursuant to K-6 and K-8 and ROP E-23, when a pipeline project is proposed.

The southern and eastern portions of the Utukok River Uplands Special Area would be available for new infrastructure. Alternative C would not recommend any rivers for addition to the Wild and Scenic Rivers system; however, the BLM would manage the existing 12 suitable rivers to protect their free flow, water quality, and outstandingly remarkable values.

2.2.5 Alternative D

Alternative D would make the most land available for leasing (18.3 million acres, or 81 percent of NPR-A's subsurface estate) and the least land closed to new infrastructure (4.5 million acres). The management of the Utukok River Uplands, Kasegaluk Lagoon, and Peard Bay Special Areas would be the same as that under Alternative C. Under Alternative D, all of the Teshekpuk Lake Special Area would be available for leasing, with impacts on caribou calving habitat and important bird habitat partially mitigated through no surface occupancy stipulations and timing limitations.

No pipeline corridors would be needed in the Teshekpuk Lake Special Area under Alternative D because more areas would be open to new infrastructure, including where pipelines may be needed to transport oil and gas from offshore leases (see **Appendix A**, **Map 2-15 and Map 2-16**). As with Alternative C, Alternative D would not recommend any rivers for addition to the Wild and Scenic Rivers system and the BLM would manage the existing 12 suitable rivers to protect their free flow, water quality, and outstandingly remarkable values.

2.2.6 Lease Stipulations, Required Operating Procedures, and Lease Notices

Protective measures under Alternatives B, C, and D are of two types: oil and gas lease stipulations and ROPs for both oil and gas and non-oil and gas activities requiring authorization from the BLM (see **Table 2-2**, below). Examples of non-oil and gas activities are transportation and communication rights-of-way, research permits, sand and gravel mining, and special recreation permits. While the language in lease stipulations and ROPs refers only to the BLM or its AO, it is understood that all activities, including plan development, study development, and consideration of exceptions, modifications, or waivers, would include appropriate coordination with federal, State, and NSB agencies, Tribes, ANCSA corporations, and other Native organizations, as appropriate.

Lease Stipulations

Appropriate stipulations are attached to an oil and gas lease when the BLM issues it. As part of a lease contract, stipulations are specific to the lease. All oil and gas activity permits issued to a lessee must comply with the lease stipulations appropriate to the activity under review, such as exploratory drilling or production pad construction.

A stipulation included in an oil and gas lease would be subject to the following, as appropriate:

- A waiver—A permanent exemption to a stipulation on a lease
- An exception—A one-time exemption to a lease stipulation, determined on a case-by-case basis
- A modification—A change attached to a lease stipulation, either temporarily or for the life of the lease

The AO may authorize a modification to a lease stipulation only if she or he determines that the factors leading to the stipulation have changed sufficiently to make the stipulation no longer justified; the proposed operation would still have to meet the objective stated for the stipulation.

While the BLM may grant a waiver, exception, or modification of a stipulation through the permitting process, it may also impose additional requirements through permitting terms and conditions to meet the objectives of any stipulation. This would be the case if the AO considers that such requirements are warranted to protect the land and resources, in accordance with the BLM's responsibility under relevant laws and regulations.

Required Operating Procedures

The ROPs under Alternatives B, C, and D describe the protective measures that the BLM would require of applicants during the permitting process. Together with the lease stipulations, the ROPs also provide a basis for analyzing the potential impacts of Alternatives B, C, and D in this IAP/EIS. (In the 2013 NPR-A IAP ROD, best management practices (BMPs) was the term that the BLM used instead of ROPs. The BLM is using ROPs in this IAP/EIS to maintain consistent terminology between on-going leasing and development plans on the North Slope.) ROP refers to both BMPs and ROPs throughout the document.

ROPs apply to both oil and gas activities and any other permitted activity in the NPR-A. Any applicant requesting authorization for an activity from the BLM would have to address the applicable ROPs in one of the following ways:

- Before submitting the application (e.g., performing and documenting subsistence consultation or surveys)
- As part of the application proposal (e.g., including in the proposal statements that the applicant would meet the objective of the ROP and how the applicant intends to achieve that objective)
- As a term imposed by the BLM in a permit

At the permitting stage, the AO would not include those ROPs that, because of their location or other inapplicability, are not relevant to a specific permit application. Note also that at the permit stage, the AO may establish additional requirements to protect the land and resources, in accordance with the BLM's responsibility under relevant laws and regulations.

In the rest of this IAP/EIS, the term *permittee* is used to include anyone who is bound by the terms of the authorization, such as the lessee, operator, contractor, or permittee.

Lease Notices

A lease notice provides information to lessees, including how BLM intends to assure compliance with certain laws (e.g., the Endangered Species Act) and regulations that may apply to oil and gas activities conducted pursuant to the lease. Lease notices do not impose new requirements.

Table 2-2
Lease Stipulations, Required Operating Procedures, and Lease Notices

Alternative A	Alternatives B, C, and D
A. Waste Prevention, Handling, Disposal, Spills, and Public Safety	
BMP A-1 Objective: Protect the health and safety of oil and gas field workers and the general public by disposing of solid waste and garbage in accordance with applicable federal, State, and local laws and regulations. Requirement/Standard: Areas of operation shall be left clean of all debris.	***ROP A-1: Waste and Litter*** Objective: Protect public health, safety, and the environment by disposing of solid waste and garbage in accordance with applicable federal, State, and local laws and regulations. Requirement/Standard: Areas of operation shall be left clean of all debris. All solid waste and industry-derived trash originating from permitted activities is required to be properly containerized while on-site or removed from the area of operation and activity.
BMP A-2 Objective: Minimize impacts on the environment from nonhazardous and hazardous waste generation. Encourage continuous environmental improvement. Protect the health and safety of oil field workers and the general public. Avoid human-caused changes in predator populations. Requirement/Standard: Lessees/permittees shall prepare and implement a comprehensive waste management plan for all phases of exploration and development, including seismic activities. The plan shall be submitted to the AO for approval, in consultation with federal, State, and NSB regulatory and resource agencies, as appropriate (based on agency legal authority and jurisdictional responsibility), as part of a plan of operations or other similar permit application. Management decisions affecting waste generation shall be addressed in the following order of priority: 1) prevention and reduction, 2) recycling, 3) treatment, and 4) disposal. The plan shall consider and take into account the following requirements: a. Methods to avoid attracting wildlife to food and garbage. The plan shall identify precautions that are to be taken to avoid attracting wildlife to food and garbage. b. Disposal of putrescible waste. Requirements prohibit the burial of garbage. Lessees and permitted users shall have a written procedure to ensure that the handling and disposal of putrescible waste will be accomplished in a manner that prevents the attraction of wildlife. All putrescible waste shall be incinerated, backhauled, or composted in a manner approved by the AO. All solid waste, including incinerator ash, shall be disposed of in an approved waste-disposal facility in accordance with Environmental Protection Agency (EPA) and Alaska Department of Environmental Conservation (ADEC) regulations and procedures. The burial of human waste is prohibited, except as authorized by the AO. c. Disposal of pumpable waste products. Except as specifically provided, the BLM requires that all pumpable solid, liquid, and sludge waste be disposed of by injection, in accordance with EPA, ADEC, and the Alaska Oil and Gas Conservation Commission regulations and procedures. On-pad temporary muds and cuttings storage, as approved by ADEC will be allowed as necessary to facilitate annular injection and/or backhaul operations. d. Disposal of wastewater and domestic wastewater. The BLM prohibits wastewater discharges or disposal of domestic wastewater into bodies of fresh, estuarine, and marine water, including wetlands, unless authorized by a National Pollutant Discharge Elimination System or State permit.	***ROP A-2: Waste Management Plan*** Objective: Minimize impacts on the environment from nonhazardous and hazardous waste generation. Encourage continuous environmental improvement. Protect the health and safety of oil field workers, local communities, subsistence users, recreationists, and the general public. Avoid human-caused changes in predator populations. Minimize attraction of predators, particularly bears, to human use areas. Requirement/Standard: The lessee/operator/contractor would prepare and implement a comprehensive waste management plan for all phases of exploration, development, and production, including seismic activities. The plan would include methods and procedures to use bear-resistant containers for all waste materials and classes. The plan would be submitted to the AO for approval, in consultation with federal, State, and NSB regulatory and resource agencies, as appropriate (based on agency legal authority and jurisdictional responsibility), as part of a plan of operations or other similar permit application. Management decisions affecting waste generation would be addressed in the following order of priority: 1) prevention and reduction, 2) recycling, 3) treatment, and 4) disposal. The plan would consider and take into account the following requirements: a. Comply with requirements of **ROP A-4**. b. Disposal of food or other organic waste. Requirements prohibit the burial of garbage. Lessees and permitted users shall have a written procedure to ensure that the handling and disposal of food or other organic waste will be accomplished in a manner that prevents the attraction of wildlife. All food or other organic waste shall be incinerated, backhauled, or composted in a manner approved by the AO. All solid waste, including incinerator ash, shall be disposed of in an approved waste-disposal facility, in accordance with EPA and ADEC regulations and procedures. The burial of human waste is prohibited, except as authorized by the AO. c. Disposal of pumpable waste products. Except as specifically provided, the BLM requires that all pumpable solid, liquid, and sludge waste be disposed of by injection, in accordance with EPA, ADEC, and the Alaska Oil and Gas Conservation Commission regulations and procedures. On-pad temporary muds and cuttings storage, as approved by ADEC, will be allowed as necessary to facilitate annular injection and/or backhaul operations.
BMP A-3 Objective: Minimize pollution through effective hazardous-materials contingency planning. Requirement/Standard: For oil- and gas-related activities, a hazardous materials emergency contingency plan shall be prepared and implemented before transportation, storage, or use of fuel or hazardous substances. The plan shall include a set of procedures to ensure prompt response, notification, and cleanup in the event of a hazardous substance spill or threat of a release. Procedures in the plan applicable to fuel and hazardous substances handling (associated with transportation vehicles) shall consist of BMPs if approved by the AO. The plan shall include a list of resources available for response (e.g., heavy-equipment operators, spill-cleanup materials or companies), and names and phone numbers of federal, State, and NSB contacts. Other federal and State regulations may apply and require additional planning requirements. All appropriate staff shall be instructed regarding these procedures. In addition, contingency plans related to facilities developed for oil production shall include requirements to: a. Provide refresher spill-response training to NSB and local community spill-response teams on a yearly basis. b. Plan and conduct a major spill-response field-deployment drill annually. c. Prior to production and as required by law, develop spill prevention and response contingency plans and participate in development and maintenance of the North Slope Subarea Contingency Plan for Oil and Hazardous Substances Discharges/Releases for the NPR-A operating area. Planning shall include development and funding of detailed (e.g., 1:26,000 scale) environmental sensitivity index maps for the lessee's/permittee's operating area and areas outside the lessee's/permittee's operating area that could be affected by their activities. (The specific area to be mapped shall be defined in the lease agreement and approved by the AO in consultation with appropriate resource agencies.) Maps shall be completed in paper copy and geographic information system format in conformance with the latest version of the U.S. Department of Commerce, National Oceanic and Atmospheric Administration's Environmental Sensitivity Index Guidelines. Draft and final products shall be peer reviewed and approved by the AO in consultation with appropriate federal, State, and NSB resource and regulatory agencies.	***ROP A-3*** Objective: Minimize pollution through effective hazardous substances contingency planning. Requirement/standard: For oil and gas-related activities, a hazardous substances contingency plan shall be prepared and implemented before transportation, storage, or use of hazardous substances. The plan shall include the following: • Identification of the hazardous substances • Procedures for proper storage and handling of the hazardous substances • Procedures for prompt response, notification, and cleanup in the event of a release If the elements of this plan are included in documents prepared to meet other federal, State, or local requirements, the AO may approve referencing the appropriate documents instead of preparing a hazardous substances contingency plan.

Alternative A	Alternatives B, C, and D
BMP A-4 Objective: Minimize the impact of contaminants on fish, wildlife, and the environment, including wetlands, marshes, and marine waters, as a result of fuel, crude oil, and other liquid chemical spills. Protect subsistence resources and subsistence activities. Protect public health and safety. Requirement/Standard: Before initiating any oil and gas or related activity or operation, including field research/surveys and/or seismic operations, lessees/permittees shall develop a spill prevention, control, and countermeasure plan, per 40 CFR 112 (Oil Pollution Act). The plan shall consider and take into account the following requirements: a. On-site Clean-up Materials. Sufficient oil-spill-cleanup materials (absorbents, containment devices, etc.) shall be stored at all fueling points and vehicle-maintenance areas and shall be carried by field crews on all overland moves, seismic work trains, and similar overland moves by heavy equipment. b. Storage Containers. Fuel and other petroleum products and other liquid chemicals shall be stored in proper containers at approved locations. Except during overland moves and seismic operations, fuel, other petroleum products, and other liquid chemicals designated by the AO that in total exceed 1,320 gallons shall be stored within an impermeable lined and diked area or within approved alternate storage containers, such as over packs, capable of containing 110% of the stored volume. In areas within 500 feet of water bodies, fuel containers are to be stored within appropriate containment. c. Liner Material. Liner material shall be compatible with the stored product and capable of remaining impermeable during typical weather extremes expected throughout the storage period. d. Permanent Fueling Stations. Permanent fueling stations shall be lined or have impermeable protection to prevent fuel migration to the environment from overfills and spills. e. Proper Identification of Containers. All fuel containers, including barrels and propane tanks, shall be marked with the responsible party's name, product type, and year filled or purchased. f. Notice of Reportable Spills. Notice of any reportable spill (as required by 40 CFR 300.125 and 18 Alaska Administrative Code (AAC) 75.300) shall be given to the AO as soon as possible, but no later than 24 hours after occurrence. g. Identification of Oil Pans ("duck ponds"). All oil pans shall be marked with the responsible party's name.	***ROP A-4: Spill Prevention*** Objective: Minimize the impact of contaminants on fish, wildlife, and the environment, including wetlands, marshes, and marine waters, as a result of fuel spills. Protect subsistence resources and subsistence activities. Protect public health and safety. Requirement/Standard: Permittees with oil storage capacity of 1,320 gallons or greater shall prepare a spill prevention, control, and countermeasure plan as required by 40 CFR 112. a. Notice of any spill shall be given to the AO as soon as possible but no later than 24 hours after occurrence. Other federal, State, and NSB entities shall be notified as required by law. b. All spills shall be cleaned up immediately and to the satisfaction of the AO and all agencies with regulatory authority over spills. c. Sufficient oil spill cleanup materials (sorbent pads, containment devices, etc.) shall be stored at all fueling points and maintenance areas. Drip basins and/or sorbent pads would be placed under all non-dry disconnect type fuel line couplings and valves during fueling. d. All duck ponds and fuel containers, including barrels, propane tanks, shall be marked with the Permittee's name, product type, and year filled or purchased.
BMP A-5 Objective: Minimize the impact of contaminants from refueling operations on fish, wildlife, and the environment. Requirement/Standard: Refueling of equipment within 500 feet of the active floodplain of any water body is prohibited. Fuel storage stations shall be located at least 500 feet from any water body with the exception that small caches (up to 210 gallons) for motor boats, float planes, ski planes, and small equipment, e.g. portable generators and water pumps, are permitted. The AO may allow storage and operations at areas closer than the stated distances if properly designed to account for local hydrologic conditions.	***ROP A-5: Refueling and Fuel Storage*** Objective: Minimize the impact of contaminants from refueling operations on fish, wildlife, and the environment. Requirement/Standard: Refueling of equipment within 100 feet of the active floodplain of any water body is prohibited. Fuel storage stations shall be located at least 100 feet from any water body with the exception of small caches (up to 210 gallons). The AO may allow storage and operations at areas closer than the stated distances if properly designed to account for local hydrologic conditions.
BMP A-6 Objective: Minimize the impact on fish, wildlife, and the environment from contaminants associated with the exploratory drilling process. Requirement/Standard: Surface discharge of reserve-pit fluids is prohibited.	No similar requirement; reserve pits are no longer used.
BMP A-7 Objective: Minimize the impacts on the environment of disposal of produced fluids recovered during the development phase on fish, wildlife, and the environment. Requirement/Standard: Discharge of produced water in upland areas and marine waters is prohibited.	No similar requirement; discharges of produced fluids are addressed by the State of Alaska under the water quality standards, wastewater discharge, and permitting requirements contained in 18 AAC 70, 18 AAC 72, and 18 AAC 83.
BMP A-8 Objective: Minimize conflicts resulting from interaction between humans and bears during oil and gas activities. Requirement/Standard: Oil and gas lessees and their contractors and subcontractors shall, as a part of preparation of lease operation planning, prepare and implement bear-interaction plans to minimize conflicts between bears and humans. These plans shall include measures to: a. Minimize attraction of bears to the drill sites. b. Organize layout of buildings and work sites to minimize human/bear interactions. c. Warn personnel of bears near or on work sites and identify proper procedures to be followed. d. Establish procedures, if authorized, to discourage bears from approaching the work site. e. Provide contingencies in the event bears do not leave the site or cannot be discouraged by authorized personnel. f. Discuss proper storage and disposal of materials that may be toxic to bears. g. Provide a systematic record of bears on the work site and in the immediate area.	***ROP A-8: Wildlife Interaction Plan*** Objective: Minimize conflicts between humans and wildlife and avoid human-caused increases in predator populations. Requirement/Standard: Permittees shall prepare and implement wildlife interaction plans to minimize conflicts between wildlife and humans. These plans shall include measures to: • Minimize attraction of wildlife to activity sites. • Organize layout of buildings and work sites to minimize human/wildlife interactions. • Warn personnel of bears near or on work sites and identify proper procedures to be followed. • Establish procedures, if authorized, to discourage wildlife from approaching the work site. • Provide contingencies in the event bears do not leave the site or cannot be discouraged by authorized personnel. • Establish proper storage and disposal of materials that may be toxic to wildlife. • Provide, annually, a systematic record of bears on and near the project area. • Permittees shall use best available technology to prevent infrastructure from providing nesting, denning, or shelter sites for ravens, raptors, and foxes. The permittee shall provide the AO with an annual report on the use of infrastructure by ravens, raptors, and foxes. • Feeding wildlife is prohibited. • Permittee will prevent the emission of odors by installing kitchen hood exhaust filtration systems such as cleaners, filters, purifiers, and scrubbers. • Activities not covered under an incidental take regulation must include the following in their wildlife interaction plan: – Guidelines for safe and nonlethal deterrence of polar bears from damaging property and endangering the public, as found in

Alternative A	Alternatives B, C, and D
(see above)	the Final Rule of the Marine Mammal Protection Act Deterrence Guidelines – Other methods of deterring polar bears require authorization by the U.S. Fish and Wildlife Service (USFWS) Marine Mammals Management Office. – If a polar bear interaction escalates into a life-threatening situation, Section 101(c) of the Marine Mammal Protection Act allows, without specific authorization, to take (including lethal take) a polar bear. – Any injury or lethal take of a polar bear must be reported to the USFWS and the BLM within 24 hours.
BMP A-9 Objective: Reduce air quality impacts. Requirement/Standard: All oil and gas operations (vehicles and equipment) that burn diesel fuels must use "ultra-low sulfur" diesel as defined by the ADEC Division of Air Quality.	No similar requirement; duplicative with EPA standard under Section 202 of the Clean Air Act amendments.
BMP A-10 Objective: Prevent unnecessary or undue degradation of the lands and protect health. Requirement/Standard: This measure includes the following elements: a. Prior to initiation of a NEPA analysis for an application to develop a central production facility, production pad/well, airstrip, road, gas compressor station, or other potential substantial air pollutant emission source (hereafter project), the AO may require the project proponent to provide a minimum of one year of baseline ambient air monitoring data for any pollutant(s) of concern, as determined by BLM if no representative air monitoring data are available for the project area, or existing representative ambient air monitoring data are insufficient, incomplete, or do not meet minimum air monitoring standards set by the ADEC or the EPA. If BLM determines that baseline monitoring is required, this pre-analysis data must meet ADEC and EPA air monitoring standards and cover the year immediately prior to the submittal. Pre-project monitoring may not be appropriate where the life of the project is less than one year. b. The BLM may require monitoring for the life of the project, depending on the magnitude of potential air emissions from the project, proximity to a federally mandated Class I area, sensitive Class II area (as identified on a case-by-case basis by ADEC or a federal land management agency), or population center, location within or proximity to a non-attainment or maintenance area, meteorological or geographic conditions, existing air quality conditions, magnitude of existing development in the area, or issues identified during NEPA undertaken for the project. c. For an application to develop a central production facility, production pad/well, airstrip, road, gas compressor station, or other potential substantial air pollutant emission source, the project proponent shall prepare (and submit for BLM approval) an emissions inventory that includes quantified emissions of regulated air pollutants from all direct and indirect sources related to the proposed project, including reasonably foreseeable air pollutant emissions of criteria air pollutants, volatile organic compounds, hazardous air pollutants, and greenhouse gases estimated for each year for the life of the project. The BLM would use this estimated emissions inventory to identify pollutants of concern and to determine the appropriate level of air analysis to be conducted for the proposed project. d. For an application to develop a central production facility, production pad/well, airstrip, road, gas compressor station, or other potential substantial air pollutant emission source, the BLM may require the proponent to provide an emissions reduction plan that includes a detailed description of operator committed measures to reduce project-related air pollutant emissions, including, but not limited to greenhouse gases and fugitive dust. e. For an application to develop a central production facility, production pad/well, airstrip, road, gas compressor station, or other potential substantial air pollutant emission source, the AO may require air quality modeling for purposes of analyzing project direct, indirect or cumulative impacts on air quality. The BLM may require air quality modeling, depending on the magnitude of potential air emissions from the project or activity, duration of the proposed action, proximity to a federally mandated Class I area, sensitive Class II area (as identified on a case-by-case basis by ADEC or a federal land management agency), or population center, location within a non-attainment or maintenance area, meteorological or geographic conditions, existing air quality conditions, magnitude of existing development in the area, or issues identified during NEPA undertaken for the project. The BLM would determine the information required for a project-specific modeling analysis through the development of a modeling protocol for each analysis. The AO would consult with appropriate federal, State, and/or local agencies regarding modeling to inform his/her modeling decision and avoid duplication of effort. The modeling shall compare predicted impacts on all applicable local, State, and federal air quality standards and increments, as well as other scientifically defensible significance thresholds, such as impacts on air quality related values and incremental cancer risks. f. The BLM may require air quality mitigation measures and strategies within its authority (and in consultation with local, State, federal, and tribal agencies with responsibility for managing air resources), in addition to regulatory requirements and proponent-committed emission reduction measures, and for emission sources not otherwise regulated by ADEC or EPA, if the air quality analysis shows potential future impacts on NAAQS or AAAQS or impacts above specific levels of concern for air quality related values. g. If ambient air monitoring indicates that project-related emissions are causing or contributing to impacts that would cause unnecessary or undue degradation of the lands, cause exceedances of NAAQS, or fail to protect health (either directly or through use of subsistence resources), the AO may require changes in activities at any time to reduce these emissions to comply with the NAAQS and/or minimize impacts on air quality related values. Within the scope of BLM's authority, the BLM may require additional emission control strategies to minimize or reduce impacts on air quality.	***ROP A-10: Air Quality*** Objective: Prevent unnecessary or undue degradation of the air and lands and protect health. Requirement/Standard: This measure includes the following elements: a. All projects and permitted uses will comply with all applicable National and Alaska Ambient Air Quality Standards (NAAQS/AAAQS) and ensure air quality related values are protected under the Clean Air Act or other applicable statutes. b. Prior to initiation of a NEPA analysis begins for an application to develop a central processing facility, production pad/well, airstrip, road, gas compressor station, or other potential air pollutant emission source (hereafter called project), the BLM AO may require the project proponent to provide a minimum of 1 year of baseline ambient air monitoring data for pollutants of concern, as determined by the BLM. This would apply if no representative air monitoring data are available for the project area or if existing representative ambient air monitoring data are insufficient, incomplete, or do not meet minimum air monitoring standards set by the ADEC or the EPA. If the BLM determines that baseline monitoring is required, this pre-analysis data must meet ADEC and EPA air monitoring standards and cover the year before the submittal. Pre-project monitoring may not be appropriate where the life of the project is less than 1 year. c. For an application to develop a central production facility, production pad/well, airstrip, road, gas compressor station, or other potential substantial air pollutant emission source, the project proponent shall prepare and submit for BLM approval an emissions inventory that includes quantified emissions of regulated air pollutants from all direct and indirect sources related to the proposed project. This includes reasonably foreseeable air pollutant emissions of criteria air pollutants, volatile organic compounds, hazardous air pollutants, and greenhouse gases estimated for each year for the life of the project. The BLM uses this estimated emissions inventory to identify pollutants of concern and to determine the appropriate form of air analysis to be conducted for the proposed project. d. The BLM may require air quality modeling for purposes of analyzing project direct, indirect, or cumulative impacts on air quality. The BLM may require air quality modeling depending on the following: 1) The magnitude of potential air emissions from the project 2) Proximity to a federally mandated Class I area 3) Proximity to a population center 4) Location in or proximity to a nonattainment or maintenance area 5) Meteorological or geographic conditions 6) Existing air quality conditions 7) Magnitude of existing development in the area 8) Issues identified during the NEPA process e. The BLM will determine the information required for a project-specific modeling analysis through the development of a modeling protocol for each analysis. The BLM will consult with appropriate federal (including federal land managers), State, and/or local agencies regarding modeling to inform its modeling decision and avoid duplication of effort. The modeling shall compare predicted impacts on all applicable local, State, and federal air quality standards and increments, as well as other scientifically defensible significance thresholds, such as impacts on air quality related values and incremental cancer risks. f. The BLM may require the proponent to provide an emissions reduction plan that includes a detailed description of operator-committed measures to reduce project-related air pollutant emissions, including, but not limited to, criteria pollutants, greenhouse gases, heavy metals, mercury, and fugitive dust. g. Air monitoring or air modeling reports will be provided to the BLM, federal land managers, federal, State, local community, or Tribal governments, and other interested parties, as appropriate. h. The BLM may require monitoring for the life of the project, depending on the following: • The magnitude of potential air emissions from the project • Proximity to a federally mandated Class I area • Proximity to a population center • Location within or proximity to a nonattainment or maintenance area • Meteorological or geographic conditions • Existing air quality conditions • Magnitude of existing development in the area

Alternative A	Alternatives B, C, and D
h. Publicly available reports on air quality baseline monitoring, emissions inventory, and modeling results developed in conformance with this BMP shall be provided by the project proponent to the NSB and to local communities and Tribes in a timely manner.	- Issues identified during the NEPA process i. If ambient air monitoring or air quality modeling indicates that project-related emissions cause or contribute to impacts, unnecessary or undue degradation of the lands, or exceedances of the NAAQS/AAAQS or if it fails to protect health (either directly or through use of subsistence resources), then the BLM may require changes or additional emission control strategies. To reduce or minimize emissions from proposed activities to comply with the NAAQS/AAAQS and/or minimize impacts to air quality related values, the BLM shall consider air quality mitigation measures within its authority, in addition to regulatory requirements and proponent-committed emission reduction measures, and also for emission sources not otherwise regulated by ADEC or the EPA. Mitigation measures will be analyzed through appropriate NEPA analysis to determine effectiveness. The BLM will consult with the federal land managers and other appropriate federal, State, and/or local agencies to determine potential mitigation options for any predicted significant impacts from the proposed project development. j. In a timely manner, the project proponent shall provide to the NSB and local communities and tribes publicly available reports on air quality baseline monitoring, emissions inventory, and modeling results developed in conformance with this ROP.
BMP A-11 Objective: Ensure that permitted activities do not create human health risks through contamination of subsistence foods. Requirement/Standard: A lessee proposing a permanent oil and gas development shall design and implement a monitoring study of contaminants in locally used subsistence foods. The monitoring study shall examine subsistence foods for all contaminants that could be associated with the proposed development. The study shall identify the level of contaminants in subsistence foods prior to the proposed permanent oil and gas development and monitor the level of these contaminants throughout the operation and abandonment phases of the development. If ongoing monitoring detects a measurable and persistent increase in a contaminant in subsistence foods, the lessee shall design and implement a study to determine how much, if any, of the increase in the contaminant in subsistence foods originates from the lessee's activities. If the study determines that a portion of the increase in contamination in subsistence foods is caused by the lessee's activities, the AO may require changes in the lessee's processes to reduce or eliminate emissions of the contaminant. The design of the study/studies must meet the approval of the AO. The AO may consult with appropriate federal, State, and NSB agencies prior to approving the study/studies design. The AO may require/authorize changes in the design of the studies throughout the operations and abandonment period, or terminate or suspend studies if results warrant.	No similar requirement.
BMP A-12 Objective: To minimize negative health impacts associated with oil spills. Requirement/Standard: If an oil spill with potential impacts on public health occurs, the BLM, in undertaking its oil spill responsibilities, would consider: a. Immediate health impacts and responses for affected communities and individuals. b. Long-term monitoring for contamination of subsistence food sources. c. Long-term monitoring of potential human health impacts. d. Perceptions of contamination and subsequent changes in consumption patterns. e. Health promotion activities and communication strategies to maintain the consumption of traditional food.	No similar requirement; this describes the BLM's responsibility, and it is not a requirement of a permittee.
No similar requirement.	***ROP A-13: Firefighting Foam Standards*** Objective: To prevent the release of poly- and perfluoroalkyl substances associated with the use of aqueous film-forming foam, a firefighting foam designed to extinguish flammable and combustible liquids and gases. Requirement/Standard: At facilities where fire-fighting foam is required, use fluorine-free foam unless other State or federal regulations require aqueous film-forming foam use. If aqueous film-forming foam use is required, contain, collect, treat, and properly dispose of all runoff, wastewater from training events, and, to the greatest extend possible, from any emergency response events. All discharges must be reported to the ADEC. Measures should also be taken to fully inform workers/trainees of the potential health risks of fluorinated foams and to specify appropriate personal protective equipment to limit exposure during training and use. Training events shall be conducted in lined areas or basins to prevent the release of poly- and perfluoroalkyl substances associated with aqueous film-forming foam.
No similar requirement.	***ROP A-14: Vehicle Idling Standards*** Objective: Reduce air emissions and protect human health. Requirement/Standard: a. All permanent camps are required to use vehicle plug-ins for engine block heaters. When vehicles are not in use they shall be powered off and plugged in where plugs are available.
B. Water Use for Permitted Activities	
BMP B-1 Objective: Maintain populations of, and adequate habitat for, fish and invertebrates. Requirement/Standard: Withdrawal of unfrozen water from rivers and streams during winter is prohibited. The removal of ice aggregate from grounded areas ≤4 feet deep may be authorized from rivers on a site-specific basis.	***ROP B-1: Water Use from Rivers and Streams*** Same as Alternative A.

Alternative A	Alternatives B, C, and D
BMP B-2 Objective: Maintain natural hydrologic regimes in soils surrounding lakes and ponds, and maintain populations of, and adequate habitat for, fish, invertebrates, and waterfowl. Requirement/Standard: Withdrawal of unfrozen water from lakes and the removal of ice aggregate from grounded areas ≤4 feet deep may be authorized on a site-specific basis, depending on water volume and depth and the waterbody's fish community. Current water use requirements are: a. Lakes with sensitive fish (i.e., any fish except ninespine stickleback or Alaska blackfish): unfrozen water available for withdrawal is limited to 15% of calculated volume deeper than 7 feet; only ice aggregate may be removed from lakes that are ≤7 feet deep. b. Lakes with only non-sensitive fish (i.e., ninespine stickleback or Alaska blackfish): unfrozen water available for withdrawal is limited to 30% of calculated volume deeper than 5 feet; only ice aggregate may be removed from lakes that are ≤5 feet deep. c. Lakes with no fish present, regardless of depth: water available for use is limited to 35% of total lake volume. d. In lakes where unfrozen water and ice aggregate are both removed, the total use shall not exceed the respective 15%, 30%, or 35% volume calculations. e. Additional modeling or monitoring may be required to assess water level and water quality conditions before, during, and after water use from any fish-bearing lake or lake of special concern. f. Any water intake structures in fish-bearing or non-fish-bearing waters shall be designed, operated, and maintained to prevent fish entrapment, entrainment, or injury. Note: All water withdrawal equipment must be equipped and must utilize fish screening devices approved by the Alaska Department of Fish and Game Division of Habitat. g. Compaction of snow cover or snow removal from fish-bearing waterbodies shall be prohibited except at approved ice road crossings, water pumping stations on lakes, or areas of grounded ice.	***ROP B-2: Water Use from Lakes*** Objective: Maintain natural hydrologic regimes in soils surrounding lakes and ponds and maintain populations of, and adequate habitat for, fish, aquatic invertebrates, and birds. Requirement/Standard: Withdrawal of unfrozen water from lakes and the removal of ice aggregate from grounded areas 4 feet deep or less during winter and withdrawal of water from lakes during the summer may be authorized on a site-specific basis, depending on water volume and depth, the fish community, and connectivity to other lakes or streams. Winter Water Use a. Lakes with sensitive fish (i.e., any fish except ninespine stickleback or Alaska blackfish): unfrozen water available for withdrawal is limited to 15% of calculated volume deeper than 7 feet. b. Lakes with only non-sensitive fish (i.e., ninespine stickleback or Alaska blackfish): unfrozen water available for withdrawal is limited to 30% of calculated volume deeper than 5 feet. c. Lakes with no fish, regardless of depth: unfrozen water available for withdrawal is limited to 20% of total lake volume. d. Ice aggregate may be removed from grounded areas 4 feet deep or less on any lake. The combination of unfrozen water and ice aggregate must not exceed 20% of total lake volume at lakes with resistant fish species only and lakes with no fish. The combination of unfrozen water and ice aggregate must not exceed 15% of total lake volume at lakes with sensitive fish species. e. Compacting snow cover or removing snow from ungrounded ice areas of fish-bearing water bodies would be prohibited, except at approved ice road and snow trail stream crossings, water pumping stations on lakes, and ice airstrips on lakes. Additional data collection may be required at ice airstrips. Summer Water Use a. Requests for summer water use must be made separately, and the volume allowance would be evaluated on a case-by-case basis. Approval from the BLM AO is required. All Water Use a. Any water intake structures in fish-bearing or non-fish-bearing waters shall be designed, operated, and maintained to prevent fish entrapment, entrainment, or injury. All water withdrawal equipment must be equipped with and use fish screening devices approved by the Alaska Department of Fish and Game Division of Habitat. b. Additional modeling or monitoring may be required to assess lake water level, outlet flow, and/or water quality conditions before, during, and after water use from any lake of special concern. c. A daily record of water removed as unfrozen water or ice aggregate (separately) must be maintained and submitted to the BLM with the weekly report of activities. Submitting water and ice use in the format specified by the BLM is required. d. The BLM must be notified within 48 hours if water removal exceeds the volume approved at any lake. e. The BLM must be notified within 48 hours of any observation of dead or injured fish on water source intake screens, in the hole being used for pumping, or within any portion of ice roads or pads. If observed at a particular lake, pumping must cease temporarily from that hole until additional preventive measures are taken to avoid further impacts on fish.
C. Winter Overland Moves and Seismic Work The following BMPs/ROPs apply to overland moves, seismic work, and any similar cross-country vehicle use of heavy equipment on non-roaded surfaces during the winter season. These restrictions do not apply to the use of such equipment on ice roads after they are constructed.	
BMP C-1 Objective: Protect grizzly bear, polar bear, and marine mammal denning and/or birthing locations. Requirement/Standard: a. Cross-country use of heavy equipment and seismic activities is prohibited within ½ mile of occupied grizzly bear dens identified by the Alaska Department of Fish and Game, unless alternative protective measures are approved by the AO in consultation with the Alaska Department of Fish and Game. b. Cross-country use of heavy equipment and seismic activity is prohibited within 1 mile of known or observed polar bear dens or seal birthing lairs. Operators near coastal areas shall conduct a survey for potential polar bear dens and seal birthing lairs and consult with the USFWS and/or National Oceanic and Atmospheric Administration-Fisheries, as appropriate, before initiating activities in coastal habitat between October 30 and April 15.	***ROP C-1: Den Buffers and Survey Requirements*** Objective: Protect grizzly bear, polar bear, and marine mammal sea ice breathing holes, lairs, and birthing locations. Requirement/Standard: a. Grizzly bear dens—Cross-country use of all vehicles, equipment, and oil and gas activity is prohibited within 0.5 miles of occupied grizzly bear dens identified by the Alaska Department of Fish and Game or the USFWS, unless alternative protective measures are approved by the BLM AO, in consultation with the Alaska Department of Fish and Game. b. Polar bear dens—Cross-country use of vehicles, equipment, oil and gas activity, and seismic survey activity is prohibited within 1 mile of known or observed polar bear dens, unless alternative protective measures are approved by the BLM AO and are consistent with the Marine Mammal Protection Act and the Endangered Species Act. c. In order to limit disturbance around known polar bear dens, implement the following: • Attempt to locate polar bear dens—Operators seeking to carry out in onshore activities in known or suspected polar bear denning habitat during the denning season (approximately November to April) must make efforts to locate occupied polar bear dens within and near areas of operation, utilizing appropriate tools, such as infrared imagery and/or polar bear scent-trained dogs. All observed or suspected polar bear dens must be reported to the USFWS prior to the initiation of activities. • Observe the exclusion zone around known polar bear dens—Operators must observe a 1.6-kilometer (1-mile operational exclusion zone around all known polar bear dens during the denning season (approximately November–April, or until the female and cubs leave the areas). Should previously unknown occupied dens be discovered within 1 mile of activities, work must cease and the USFWS must be contacted for guidance. The USFWS will evaluate these instances on a case-by-case basis to recommend the appropriate action. Potential actions may range from cessation or modification of work to conducting additional monitoring, and the holder of the authorization must comply with any additional measures specified. • Use the den habitat map developed by the U.S. Geological Survey. This measure ensures that the location of potential polar bear dens is considered when conducting activities in the coastal areas of the Beaufort Sea.

Alternative A	Alternatives B, C, and D
(see above)	• Polar bear den restrictions—Restrict the timing of the activity to limit disturbance around dens. d. In order to limit disturbance of activities to seal lairs in the nearshore area (<3 meter water depth): • Specific to seismic operations: – In open water and water ungrounded ice and before the seismic survey begins, the operator will conduct a sound source verification test to measure the distance of vibroseis sound levels through grounded ice to the 120 decibels re 1 micro Pascal threshold. Once the distance of 1 micro Pascal is determined, the operator will share it with the BLM and the National Marine Fisheries Service. The distance will be used to buffer all on-ice seismic survey activity operations from any open water or ungrounded ice throughout the project area. The operator will draft a formal study proposal and will submit it to the BLM and National Marine Fisheries Service for review and approval before the activity begins. • For all activities: – Maintain airborne sound levels of equipment below 100 decibels re 20 micro Pascals at 66 feet. If equipment will be used that differs from what was originally proposed, the applicant must inform the BLM AO and share sound levels and air and water attenuation information for the new equipment. – On-ice operations after May 1 will employ a full-time, trained, protected species observer on vehicles to ensure that all basking seals are avoided by vehicles by at least 500 feet and will ensure that all equipment with airborne noise levels above 100 decibels re 20 micro Pascals are operating at distances from observed seals that allow for the attenuation of noise to levels below 100 decibels. All sightings of seals will be reported to the BLM using a National Marine Fisheries Service -approved observation form. – Ice paths must not be greater than 12 feet wide. No driving will be allowed beyond the shoulder of the ice path or off planned routes unless necessary to avoid ungrounded ice or for other human or marine mammal safety reasons. On-ice driving routes shall minimize travel over snow/ice/topographical features that could foster the development of birthing lairs. – No unnecessary equipment or operations (e.g. camps) will be placed or used on sea ice.
BMP C-2 Objective: Protect stream banks, minimize compaction of soils, and minimize the breakage, abrasion, compaction, or displacement of vegetation. Requirement/Standard: a. Ground operations shall be allowed only when frost and snow cover are at sufficient depth and strength to protect the tundra. Ground operations shall cease when the spring snowmelt begins (approximately May 5 in the foothills area where elevations reach or exceed 500 feet, and approximately May 15 in the northern coastal areas). The exact dates would be determined by the AO. b. Low-ground-pressure vehicles shall be used for on-the-ground activities off ice roads or pads. Low-ground-pressure vehicles shall be selected and operated in a manner that eliminates direct impacts to the tundra by shearing, scraping, or excessively compacting the tundra mat. Note: This provision does not include the use of heavy equipment, such as front-end loaders and similar equipment required during ice road construction. c. Bulldozing tundra mat and vegetation, trails, or seismic lines is prohibited; however, on existing trails, seismic lines, or camps, clearing drifted snow is allowed to the extent that the tundra mat is not disturbed. d. To reduce the possibility of ruts, vehicle operators shall avoid using the same trails for multiple trips unless necessitated by serious safety or superseding environmental concern. This provision does not apply to hardened snow trails for use by low-ground-pressure vehicles such as Rolligons. e. The location of ice roads shall be designed and located to minimize compaction of soils and the breakage, abrasion, compaction, or displacement of vegetation. Offsets may be required to avoid using the same route or track in the subsequent year. f. Motorized ground vehicle use within the Colville River Special Area associated with overland moves, seismic work, and any similar use of heavy equipment shall be minimized within an area that extends 1 mile west or northwest of the bluffs of the Colville River and 2 miles on either side of the Kogosukruk and Kikiakrorak rivers and tributaries of the Kogosukruk River from April 15 through August 5, with the exception that use shall be minimized in the vicinity of gyrfalcon nests beginning March 15. Such use would remain 0.5 miles away from known raptor nesting sites, unless authorized by the AO.	***ROP C-2: Winter Tundra Travel*** Objective: Protect stream banks, minimize compaction of soils, and minimize the breakage, abrasion, compaction, or displacement of vegetation. Requirement/Standard: a. Ground operations would only be allowed when frost and snow cover are at sufficient depth, strength, density, and structure to protect the tundra. Soils must be frozen to at least 23 degrees Fahrenheit at least 12 inches below the lowest surface height (e.g., inter-tussock space). Tundra travel would be allowed when there is at least 3 inches of snow water equivalent above the highest vegetated surface (e.g., top of tussock). Snow depth and snow density must amount to no less than a snow water equivalent of 3 inches over the highest vegetated surface (e.g., top of tussock) in the NPR-A. The proponent shall submit data to the BLM to show that these conditions have been reached prior to conducting work. b. Snow survey and soil freeze-down data collected for ice road or snow trail planning and monitoring shall be submitted to the BLM with the required weekly report of operations. c. Off-road travel is prohibited except for low ground pressure vehicles. Low ground pressure vehicles are defined as vehicles with ground pressure of less than 4 psi or vehicles which have passed the Alaska Department of Natural Resources low pressure vehicle qualification certification. These vehicles would be selected and operated in a manner that eliminates direct impacts to the tundra by shearing, scraping, or excessively compacting the tundra. Note: This provision does not include the use of heavy equipment required during ice road construction; however, heavy equipment would not be allowed on the tundra until conditions in *a*, above, are met. d. Bulldozing tundra mat and vegetation, trails, or seismic lines is prohibited. Clearing or smoothing drifted snow is allowed to the extent that the tundra mat is not disturbed. Only smooth pipe snow drags would be allowed for smoothing drifted snow. e. To reduce the possibility of excessive compaction, vehicle operators would avoid using the same routes for multiple trips, unless necessitated by serious safety or environmental concerns and approved by the AO. This provision does not apply to hardened snow trails or ice roads. f. Ice roads would be designed and located to avoid the most sensitive and easily damaged tundra types, as much as practicable. Ice roads may not use the same route each year; ice roads would be offset to avoid portions of an ice road route from the previous 2 years. g. Motorized ground vehicle use associated with overland moves, seismic work, and any similar use of heavy equipment shall be minimized within an area that extends 1 mile west or northwest of the bluffs of the Colville River and 2 miles on either side of the Kogosukruk and Kikiakrorak Rivers and tributaries of the Kogosukruk River from April 15 through August 5, with the exception that use shall be minimized in the vicinity of gyrfalcon nests beginning March 15. Such use would remain 0.5 miles from known raptor nesting sites, unless authorized by the AO. h. Seismic operations and winter overland travel may be monitored by agency representatives, and the operator may be required to accommodate the representative during operations. i. Incidents of damage to the tundra shall be reported to the AO within 72 hours of occurrence. Follow-up corrective actions shall be determined in consultation with and approved by the AO. j. Provide the BLM with an as-built of all ice roads, snow trails, and ice pads after the infrastructure is completed. Data must be in the form of ESRI shapefiles, referencing the North American Datum of 1983. k. See **ROP E-13** for requirements to protect cultural and paleontological resources.

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BMP C-3 Objective: Maintain natural spring runoff patterns and fish passage, avoid flooding, prevent streambed sedimentation and scour, protect water quality, and protect stream banks. Requirement/Standard: Crossing of waterway courses shall be made using a low-angle approach. Crossings that are reinforced with additional snow or ice ("bridges") shall be removed, breached, or slotted before spring breakup. Ramps and bridges shall be substantially free of soil and debris.	***ROP C-3: Ice Bridges*** Objective: Maintain natural spring runoff patterns and fish passage, avoid flooding, prevent streambed sedimentation and scour, protect water quality, and protect stream banks. Requirement/Standard: Crossing of waterway courses shall be made using a low-angle approach. Crossings that are reinforced with additional snow or ice ("bridges") shall be removed, breached, or slotted before spring breakup. Ramps shall be removed to the extent possible without damaging stream banks. Ramps and bridges shall be substantially free of soil and debris. The permittee shall provide to the BLM any ice thickness and water depth data collected at ice road or snow trail stream crossings during the pioneering stage of road/trail construction. At the end of operations in the spring, the permittee shall provide the BLM with photographs of all stream crossings that have been removed, breached, or slotted.
BMP C-4 Objective: Avoid additional freeze-down of deepwater pools harboring overwintering fish and invertebrates used by fish. Requirement/Standard: Travel up and down streambeds is prohibited unless it can be demonstrated that there would be no additional impacts from such travel to overwintering fish or the invertebrates they rely on. Rivers, streams, and lakes shall be crossed at areas of grounded ice, whenever possible.	***ROP C-4: Winter Travel Along Streambeds*** Objective: Avoid additional freeze-down of deepwater pools harboring overwintering fish. Requirement/Standard: Construction of the primary ice road or snow trail route along streambeds is prohibited, unless it can be demonstrated by collecting ice thickness and liquid water depths that there would be no additional impacts from such travel on overwintering fish. Rivers, streams, and lakes shall be crossed at areas of grounded ice, whenever possible. Some travel up and down streambeds would be allowed by the individual vehicles collecting snow from river drifts or ice aggregate from the channel (where ice is grounded).
BMP C-5 Objective: Minimize the effects of high-intensity acoustic energy from seismic surveys on fish. Requirement/Standard: a. When conducting vibroseis-based surveys above potential fish overwintering areas (water 6 feet deep or greater ice plus liquid depth), operators shall follow recommendations by Morris and Winters (2005), that is, only a single set of vibroseis shots should be conducted if possible; if multiple shot locations are required, these should be conducted with minimal delay; multiple days of vibroseis activity above the same overwintering area should be avoided, if possible. b. When conducting air gun-based surveys in freshwater, operators shall follow standard marine mitigation measures that are applicable to fish (e.g., Minerals Management Service 2008); that is, operators shall use the lowest sound levels feasible to accomplish their data-collection needs; ramp-up techniques will be utilized (ramp up involves the gradual increase in emitted sound levels, beginning with firing a single air gun and gradually adding air guns until the desired operating level of the full array is obtained). c. When conducting explosive-based surveys, operators shall follow setback distances from fish-bearing waterbodies, based on requirements outlined by Alaska Department of Fish and Game (ADFG 1991).	***ROP C-5: Seismic Surveys Near Fish Habitat*** Objective: Minimize the effects of high-intensity acoustic energy from seismic surveys on fish. Requirement/Standard: a. Those conducting vibroseis-based surveys shall avoid potential fish overwintering areas. For freshwater this includes water 6 feet deep or greater (ice plus liquid water depth). Nearshore marine, hypersaline liquid water under ice is not considered viable overwintering habitat. If operators propose to conduct surveys over potential fish overwintering areas, a complete plan of operational details for those waterbodies (transects and vibroseis settings, including the number and frequency of shots) must be submitted to the AO for approval before proceeding. In such cases, operational details shall incorporate recommendations made by Morris and Winters (2005). Only a single set of vibroseis shots should be conducted, if possible; however, if multiple shot locations are required, these should be conducted with minimal delay. Multiple days of vibroseis activity above the same overwintering area should be avoided. b. When conducting air gun-based surveys in freshwater, operators shall follow standard marine mitigation measures that are applicable to fish (e.g., Minerals Management Service 2008): operators shall use the lowest sound levels feasible to accomplish their data-collection needs; ramp-up techniques will be utilized (ramp-up involves the gradual increase in emitted sound levels, beginning with firing a single air gun and gradually adding air guns until the desired operating level of the full array is obtained). c. When conducting explosive-based surveys, operators shall follow setback distances from fish-bearing waterbodies, based on requirements outlined by Timothy (2013).
D. Oil and Gas Exploratory Drilling	
Lease Stipulation D-1 Objective: Minimize surface impacts from exploratory drilling. Requirement/Standard: Construction of permanent or gravel oil and gas facilities shall be prohibited for exploratory drilling. Use of a previously constructed road or pad may be permitted if it is environmentally preferred.	***ROP D-1: Oil and Gas Exploratory Drilling*** Same as Alternative A. See **ROP E-13** for additional requirements applicable to exploratory drilling.
E. Facility Design and Construction	
BMP E-1 Objective: Protect subsistence use and access to subsistence hunting and fishing areas and minimize the impact of oil and gas activities on air, land, water, fish, and wildlife resources. Requirement/Standard: All roads must be designed, constructed, maintained, and operated to create minimal environmental impacts and to protect subsistence use and access to subsistence hunting and fishing areas. The AO would consult with appropriate federal, State, and NSB regulatory and resources agencies prior to approving construction of roads. Subject to approval by the AO, the construction, operation, and maintenance of oil and gas field roads is the responsibility of the lessee, unless the construction, operation, and maintenance of roads are assumed by the appropriate governing entity.	***ROP E-1: Protections for Subsistence Users*** Objective: Protect subsistence use and access to subsistence hunting and fishing areas and minimize the impact of development on subsistence resources. Requirement/Standard: All roads must be designed, constructed, maintained, and operated to avoid and minimize environmental impacts and to protect subsistence use and access to subsistence use areas. a. Subsistence pullout and access/egress ramps would be constructed in adequate numbers and at appropriate locations on all roads to facilitate access to subsistence use areas. Prior to constructing a road, permittees shall gather input from communities (tribe, corporation, and city) regarding the number and location of pullouts and associated access ramps. Permittees shall post the locations of the ramps publicly and provide a mechanism for local community members to comment on the location of the ramps. The AO may require "hardening" of the tundra around the bottom of the ramps with geo-block or other acceptable methods to prevent damage from summer use. b. Permittees shall construct a subsistence pullout and boat ramp at crossings of heavily used subsistence rivers. The AO may waive this requirement where boat access is not possible at the crossing or if consultation with the affected community determines that a boat ramp is not useful at that location. See **ROP F-4** for the list of heavily used subsistence rivers.

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(see above)	c. Permittees shall provide communities with concise policies regarding use of all roads and hunting prohibitions, if any, along the roads and near facilities. Permittees shall ensure that any road use guidelines and updated road maps are disseminated throughout the communities, including making them available online and through social media. Permittees shall include a presentation on road use policies in employee orientations, shall ensure that subcontractors have the policy for their employee orientation, and shall post policies on the roads (visible, permanent signage). d. Before ice road construction begins, permittees and contractors associated with ice road construction shall hold community meetings to describe the routes and relevant information on all ice roads that would be constructed. Permittees shall distribute copies of maps of that winter's ice roads at the meeting and make them available online. Permittees shall notify the BLM at least 2 weeks prior to the meeting and inform them of the date, time and location of the meeting, and shall provide the BLM with the meeting materials and a summary of the comments received.
Lease Stipulation E-2: Infrastructure Siting Near Water Bodies Objective: Protect fish-bearing water bodies, water quality, and aquatic habitats. Requirement/Standard: Permanent oil and gas facilities, including roads, airstrips, and pipelines, are prohibited upon or within 500 feet as measured from the ordinary high-water mark of fish-bearing waterbodies. Essential pipeline and road crossings would be permitted on a case-by-case basis (also refer to **K-1** and **K-2**). Construction camps are prohibited on frozen lakes and river ice; siting of construction camps on river sand and gravel bars is allowed and encouraged. Where leveling of trailers or modules is required and the surface has a vegetative mat, leveling shall be accomplished through blocking rather than use of a bulldozer.	***ROP E-2: Infrastructure Siting Near Water Bodies*** Objective: Protect fish-bearing waterbodies, water quality, and aquatic habitats. Requirement/Standard: Permanent infrastructure is prohibited upon or within 500 feet as measured from the ordinary high-water mark of fish-bearing waterbodies. Essential pipeline and road crossings would be permitted on a case-by-case basis (also refer to **K-1** and **K-2**). Construction camps are prohibited on frozen lakes and river ice. Where leveling of trailers or modules is required and the surface has a vegetative mat, leveling shall be accomplished through blocking rather than use of a bulldozer.
Lease Stipulation E-3 Objective: Maintain free passage of marine and anadromous fish and protect subsistence use and access to subsistence hunting and fishing. Requirement/Standard: Causeways and docks are prohibited in river mouths or deltas. Artificial gravel islands and bottom-founded structures are prohibited in river mouths or active stream channels on river deltas. Causeways, docks, artificial islands, and bottom-founded drilling structures (both temporary and permanent) shall be designed to ensure free passage of marine and anadromous fish and to prevent significant changes to nearshore oceanographic circulation patterns and water quality characteristics. A monitoring program, developed in consultation with appropriate federal, State, and NSB regulatory and resource agencies, shall be required to address the objectives of water quality and free passage of fish.	***ROP E-3: Shoreline Infrastructure*** Objective: Maintain free passage of marine and anadromous fish and protect subsistence use and access to subsistence hunting and fishing. Requirement/Standard: Linear infrastructure that connects to the shoreline (e.g., causeways, docks, etc.) is prohibited in river mouths or deltas. Artificial gravel islands and permanent bottom-founded structures are prohibited in river mouths or active stream channels on river deltas. In areas where it is permissible, linear infrastructure that connects to the shoreline shall be designed to ensure free passage of marine and anadromous fish and to prevent significant changes to nearshore oceanographic circulation patterns and water quality characteristics. BLM will require a minimum of 2 years of data on fish, circulation patterns, and water quality before approving a permit for construction. The permittee may be required to gather this data, or this requirement may be waived if an acceptable dataset already exists and is approved by the AO. A post-construction monitoring program, developed in consultation with appropriate federal, State, and NSB regulatory and resource agencies, shall be required to track circulation patterns, water quality, and fish movements around the structure.
BMP E-4 Objective: Minimize the potential for pipeline leaks, the resulting environmental damage, and industrial accidents. Requirement/Standard: All pipelines shall be designed, constructed, and operated under an AO-approved quality assurance/quality control plan that is specific to the product transported and shall be constructed to accommodate the best available technology for detecting and preventing corrosion or mechanical defects during routine structural integrity inspections.	No similar requirement; the State of Alaska enforces pipeline design and construction standards to minimize the potential for leaks under 18 AAC 75.005, 18 AAC 75.007, 18 AAC 75.045, 18 AAC 75.047, 18 AAC 75.055, 18 AAC 75.080 and 18 AAC 75.436.
BMP E-5 Objective: Minimize impacts of the development footprint. Requirement/Standard: Facilities shall be designed and located to minimize the development footprint. Issues and methods that are to be considered include: a. Use of maximum extended-reach drilling for production drilling to minimize the number of pads and the network of roads between pads. b. Sharing facilities with existing development. c. Collocation of all oil and gas facilities, except airstrips, docks, and seawater-treatment plants, with drill pads. d. Integration of airstrips with roads. e. Use of gravel-reduction technologies, e.g., insulated or pile-supported pads f. Coordination of facilities with infrastructure in support of offshore development. Note: Where aircraft traffic is a concern, consideration shall be given to balancing gravel pad size and available supply storage capacity with potential reductions in the use of aircraft to support oil and gas operations.	***ROP E-5: Minimize Development Footprint*** Objective: Minimize impacts of the development footprint. Requirement/Standard: Facilities would be designed and located to minimize the development footprint and impacts. Issues and methods that are to be considered are as follows: a. Using extended-reach drilling for production drilling to minimize the number of pads and the network of roads between pads. b. Sharing facilities with existing development. c. Collocating all oil and gas facilities with drill pads, except airstrips, docks, existing base camps, and saltwater treatment plants. d. Using gravel-reduction technologies, e.g., insulated or pile-supported pads. e. Using impermeable liners under gravel pads to minimize the potential for hydrocarbon spills. f. Coordinating facilities with infrastructure in support of adjacent development. g. When possible, locating facilities and other infrastructure outside areas identified as important for wildlife habitat, subsistence uses, and recreation. h. Where aircraft traffic is a concern, balancing gravel pad size and available supply storage capacity with potential reductions in the use of aircraft to support oil and gas operations. i. See **ROP M-5** for additional requirements to reduce areas of bare soil.
BMP E-6 Objective: Reduce the potential for ice-jam flooding, impacts to wetlands and floodplains, erosion, alteration of natural drainage patterns, and restriction of fish passage. Requirement/Standard: Stream and marsh crossings shall be designed and constructed to ensure free passage of fish, reduce erosion, maintain natural drainage, and minimize adverse effects to natural stream flow. Note: Bridges, rather than culverts, are the preferred	***ROP E-6: Stream Crossing Design*** Objective: Ensure the passage of fish at stream crossings and reduce the potential for ice-dam flooding, impacts to wetlands and floodplains, erosion, and alteration of natural drainage patterns. Requirement/Standard: Stream and marsh crossings shall be designed and constructed to ensure free passage of fish, reduce erosion, maintain natural drainage, and minimize adverse effects to natural stream flow. a. To allow for sheet flow and floodplain dynamics and to ensure passage of fish and other organisms, bridges are preferred over

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method for crossing rivers. When necessary, culverts can be constructed on smaller streams, if they are large enough to avoid restricting fish passage or adversely affecting natural stream flow.	culverts. When necessary, culverts could be constructed on smaller streams, if they are large enough to avoid restricting fish passage or adversely affecting natural stream flow. b. BLM will require a minimum of 1 year of fish sampling (early summer, midsummer, and late summer) at any stream crossing where flow is channelized, and additional years of fish sampling may be required by the AO at sites where the determination of anadromous fish presence is still in question. The permittee may be required to gather this data, or this requirement may be waived if an acceptable dataset already exists and is approved by the AO. c. BLM will require a minimum of 1 year of hydrologic data at stream and marsh crossings . Additional years of hydrologic data collection may be required by the AO if more information is needed to design the crossing structure in order to attain the ROP objective and meet the requirements of part e. The permittee may be required to gather this data, or this requirement may be waived if an acceptable dataset already exists and is approved by the AO. d. To ensure that crossings provide for fish passage, all proposed crossing designs would adhere to the standards outlined in fish passage design guidelines developed by the USFWS Alaska Fish Passage Program (USFWS 2018), Stream Crossing Design Procedure for Fish Streams on the North Slope Coastal Plain (McDonald et al. 1994), Stream Simulation: An Ecological Approach to Providing Passage for Aquatic Organisms at Road-Stream Crossings (Forest Service 2008), and other generally accepted BMPs prescribed by the AO. e. The crossing structure design shall account for permafrost, sheet flow, additional freeboard during breakup, and other unique conditions of the arctic environment.
BMP E-7 Objective: Minimize disruption of caribou movement and subsistence use. Requirement/Standard: Pipelines and roads shall be designed to allow the free movement of caribou and the safe, unimpeded passage of the public while participating in subsistence activities. Listed below are the accepted design practices: a. Aboveground pipelines shall be elevated a minimum of 7 feet, as measured from the ground to the bottom of the pipeline at vertical support members. b. In areas where facilities or terrain may funnel caribou movement, ramps over pipelines, buried pipelines, or pipelines buried under roads may be required by the AO after consultation with federal, State, and NSB regulatory and resource agencies (as appropriate, based on agency legal authority and jurisdictional responsibility). c. A minimum distance of 500 feet between pipelines and roads shall be maintained. Separating roads from pipelines may not be feasible within narrow land corridors between lakes and where pipelines and roads converge on a drill pad. Where it is not feasible to separate pipelines and roads, alternative pipeline routes, designs, and possible burial within the road will be considered by the AO.	***ROP E-7: Road and Pipeline Design*** Objective: Minimize disruption of caribou movement and subsistence access. Requirement/Standard: Pipelines shall be designed to allow free movement of caribou and safe, unimpeded subsistence access. Listed below are the accepted design practices: a. Aboveground pipelines shall be elevated a minimum of 7 feet, as measured between ground and lowest point of the pipeline between vertical support members (lowest point may be the bottom of the lowest hanging vibration dampener; Lawhead et al. 2006). b. A minimum distance of 500 feet between pipelines and roads shall be maintained. Separating roads from pipelines may not be feasible within narrow land corridors between lakes and where pipelines and roads converge on a drill pad. Where it is not feasible to separate pipelines and roads, alternative pipeline routes, designs and possible burial within the road will be considered by the AO. c. Aboveground pipelines would have a nonreflective finish. d. When laying out oil and gas field developments, permittees shall orient infrastructure to minimize impeding caribou migration and to avoid corralling effects. e. Before the construction of permanent facilities is authorized, the BLM will require a study of caribou movement for the impacted herd. The permittee may be required to conduct this study, or this requirement may be waived if an acceptable study specific to that herd has been completed within the last 10 years and is approved for use by the AO.
BMP E-8 Objective: Minimize the impact of sand and gravel mining activities on air, land, water, fish, and wildlife resources. Requirement/Standard: Gravel mine site design and reclamation shall be in accordance with a plan approved by the AO. The plan shall be developed in consultation with appropriate federal, State, and NSB regulatory and resource agencies and consider: a. Locations outside the active floodplain. b. Design and construction of gravel mine sites within active floodplains to serve as water reservoirs for future use. c. Potential use of the site for enhancing fish and wildlife habitat. d. Potential storage and reuse of sod/overburden for the mine site or at other disturbed sites on the North Slope.	***ROP E-8: Sand and Gravel Mining*** Objective: Minimize the environmental impacts of mining sand and gravel. Requirement/Standard: Mine site design and reclamation shall comply with a plan developed through consultation with appropriate agencies (including, but not limited to, the BLM, U.S. Army Corps of Engineers, NSB, Natural Resources Conservation Service, Alaska Department of Fish and Game, and Alaska Department of Natural Resources) and approved by the AO. a. The plan shall consider locations outside the active floodplain or designing gravel mine sites within active floodplains to serve as water reservoirs if environmentally beneficial. b. The plan shall consider potential storage and reuse of sod/overburden for the mine site or at other disturbed sites on the North Slope. c. Removal of greater than 100 cubic yards of bedrock outcrops, sand, and/or gravel from cliffs is prohibited. d. Any extraction of sand or gravel from an active river or stream channel shall be prohibited unless preceded by a hydrological study that indicates no potential impact on streamflow, fish, turbidity, and the integrity of the river bluffs, if present.
BMP E-9 Objective: Minimize human-caused increases in populations of predators of ground-nesting birds. Requirement/Standard: a. Lessee shall utilize best available technology to prevent facilities from providing nesting, denning, or shelter sites for ravens, raptors, and foxes. The lessee shall provide the AO with an annual report on the use of oil and gas facilities by ravens, raptors, and foxes as nesting, denning, and shelter sites. b. Feeding of wildlife is prohibited and shall be subject to noncompliance regulations.	The similar requirement is combined with **ROP A-8**.
BMP E-10 Objective: Prevention of migrating waterfowl, including species listed under the Endangered Species Act, from striking oil and gas and related facilities during low light conditions. Requirement/Standard: Illumination of all structures between August 1 and October 31 shall be designed to direct artificial exterior	***ROP E-10: Facility Visibility Requirements*** Objective: Minimize bird collisions with infrastructure, especially during migration and inclement weather. Requirement/Standard: Flagging of structures shall be required, such as elevated power lines and guy wires, to minimize bird collision. All facility external lighting, during all months of the year, shall be designed to direct artificial exterior lighting inward and downward or

Alternative A	Alternatives B, C, and D
lighting inward and downward, rather than upward and outward, unless otherwise required by the Federal Aviation Administration.	be fitted with shields to reduce reflectivity in clouds and fog conditions, unless otherwise required by the Federal Aviation Administration.
BMP E-11 Objective: Minimize the take of species, particularly those listed under the Endangered Species Act and BLM special status species, from direct or indirect interaction with oil and gas facilities. Requirement/Standard: In accordance with the guidance below, before the approval of facility construction, aerial surveys of the following species shall be conducted within any area proposed for development. *Special Conditions in Spectacled and/or Steller's Eiders Habitats:* a. Surveys shall be conducted by the lessee for at least 3 years before authorization of construction, if such construction is within the USFWS North Slope eider survey area and at least 1 year outside that area. Results of aerial surveys and habitat mapping may require additional ground nest surveys. Spectacled and/or Steller's eider surveys shall be conducted following accepted BLM-protocol. Information gained from these surveys shall be used to make infrastructure siting decisions, as discussed in subparagraph b, below. b. If spectacled and/or Steller's eiders are determined to be present within the proposed development area, the applicant shall work with the USFWS and BLM early in the design process to site roads and facilities in order to minimize impacts on nesting and brood-rearing eiders and their preferred habitats. Such consultation shall address timing restrictions and other temporary mitigating measures, location of permanent facilities, placement of fill, alteration of eider habitat, aircraft operations, and management of high noise levels. c. To reduce the possibility of spectacled and/or Steller's eiders or other birds colliding with aboveground utility lines (power and communication), such lines shall either be buried in access roads or suspended on vertical support members, except in rare cases, which are to be few in number and limited in extent. Exceptions are limited to the following situations and must be reported to the USFWS when exceptions are authorized: • Overhead power or communication lines may be allowed when located entirely within the boundaries of a facility pad. • Overhead power or communication lines may be allowed when engineering constraints at the specific and limited location make it infeasible to bury or connect the lines to a vertical support member. • Overhead power or communication lines may be allowed in situations when human safety would be compromised by other methods. d. To reduce the likelihood of spectacled and/or Steller's eiders or other birds colliding with communication towers, towers should be located, to the extent practicable, on existing pads and as close as possible to buildings or other structures, and on the east or west side of buildings or other structures, if possible. Support wires associated with communication towers, radio antennas, and other similar facilities should be avoided to the extent practicable. If support wires are necessary, they should be clearly marked along their entire length to improve visibility to low-flying birds. Such markings shall be developed through consultation with the USFWS. *Special Conditions in Yellow-billed Loon Habitats:* a. Aerial surveys shall be conducted by the lessee for at least 3 years before authorization of construction of facilities proposed for development which are within 1 mile of a lake 25 acres or larger in size. These surveys along shorelines of large lakes shall be conducted following accepted BLM protocol during nesting in late June and during brood rearing in late August. b. Should yellow-billed loons be present, the design and location of facilities must be such that disturbance is minimized. The default standard mitigation is a 1-mile buffer around all recorded nest sites and a minimum 1,625-foot (500-meter) buffer around the remainder of the shoreline. Development would generally be prohibited within buffers unless no other option exists. *Protections for Birds* a. To reduce the possibility of birds colliding with aboveground utility lines (power and communication), such lines shall either be buried in access roads or suspended on vertical support members, except in rare cases, which are to be few in number and limited in extent. Exceptions are limited to the following situations: • Overhead power or communication lines may be allowed when located entirely within the boundaries of a facility pad. • Overhead power or communication lines may be allowed when engineering constraints at the specific and limited location make it infeasible to bury or connect the lines to a vertical support members. • Overhead power or communication lines may be allowed in situations when human safety would be compromised by other methods. b. To reduce the likelihood of birds colliding with communication towers, towers should be located, to the extent practicable, on existing pads and as close as possible to buildings or other structures and on the east or west side of buildings or other structures, if possible. Support wires associated with communication towers, radio antennas, and other similar facilities should be avoided to the extent practicable. If support wires are necessary, they should be clearly marked along their entire length to improve visibility to low-flying birds. Such markings shall be developed through consultation with the USFWS.	***ROP E-11: Protections for Sensitive Bird Species*** Objective: Minimize impacts on bird species, particularly those listed under the Endangered Species Act and BLM special status species, resulting from interaction with infrastructure. Requirement/Standard: In accordance with the guidance below, before the approval of infrastructure construction, the following studies shall be conducted and recommended design elements shall be incorporated. *Special Conditions in Spectacled and/or Steller's Eiders Habitats* a. BLM will require aerial surveys for at least 3 years before authorization of construction if such construction is within spectacled and Steller's eider habitats, as defined by the area contained within the USFWS Arctic Coastal Plain Aerial Waterbird Breeding Population Survey area or the Barrow Triangle Steller's Eider Survey area and at least 1 year for infrastructure construction outside those areas. The permittee may be required to gather this data, or this requirement may be waived if an acceptable dataset already exists and is approved by the AO. The BLM will evaluate the results of aerial surveys and ecological mapping (as required under **ROP E-12**) to determine if ground-based nest surveys are required. If required, spectacled and/or Steller's eider ground nest surveys shall be conducted, following accepted BLM protocol. Information gained from these surveys shall be used to make infrastructure siting decisions, as discussed in sub-paragraph b, below. Data shall be transmitted to the BLM in GIS format. b. If spectacled and/or Steller's eiders are determined to be present within the proposed development area, the applicant shall work with the USFWS and the BLM early in the design process to site roads and infrastructure in order to minimize impacts on nesting and brood-rearing eiders and their habitats. Such consultation shall address timing restrictions and other temporary mitigating measures, location of permanent infrastructure, placement of fill, alteration of eider habitat, aircraft operations, and management of noise levels. c. See **ROP E-10** for additional requirements to minimize bird collisions with infrastructure. d. See **ROP E-21** for additional requirements to reduce impacts on birds from utility lines and communication towers. *Special Conditions in Yellow-billed Loon Habitats:* The BLM shall determine the presence of yellow-billed loon habitat within a project area, using the most current data and analysis results from research conducted within the NPR-A. a. If yellow-billed loon habitat is determined to be present within the project area, the BLM will require at least 3 years of aerial surveys of lakes greater than 25 acres within one mile of proposed infrastructure. The permittee may be required to gather this data, or this requirement may be waived if an acceptable dataset already exists and is approved by the AO. These surveys along shorelines of lakes shall be conducted, following accepted BLM protocol, during nesting in late June and during brood rearing in late August. b. Should yellow-billed loons be present, the design and location of infrastructure must be such that disturbance is minimized. The default standard mitigation is a 1-mile buffer around all recorded nest sites and a minimum 1,625-foot buffer around the remainder of the shoreline. Development would generally be prohibited within buffers, unless no other option exists.
BMP E-12 Objective: Use ecological mapping as a tool to assess wildlife habitat before development of permanent facilities to conserve important habitat types during development.	***ROP E-12: Use of Ecological Mapping*** Objective: Use ecological mapping as a tool to assess fish and wildlife habitat before development of permanent infrastructure to conserve important habitat types.

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Requirement/Standard: an ecological land classification map of the development area shall be developed before approval of facility construction. The map would integrate geomorphology, surface form, and vegetation at a scale, level of resolution, and level of positional accuracy adequate for detailed analysis of development alternatives. The map shall be prepared in time to plan one season of ground-based wildlife surveys, if deemed necessary by the AO, before approval of the exact facility location and facility construction.	Requirement/Standard: An ecological land classification map, for example, vegetation and soils, of the development area shall be developed before approval of infrastructure construction. The map would integrate geomorphology, surface form, and vegetation at a scale, level of resolution, and level of positional accuracy adequate for detailed analysis of development alternatives. The map shall be prepared in time to plan one season of ground-based wildlife surveys, if deemed necessary by the AO, before approval of the exact infrastructure location and infrastructure construction. A separate map shall be developed displaying detailed water flowlines and small-scale delineation of drainage catchments based on LIDAR or other high-accuracy surface imaging.
BMP E-13 Objective: Protect cultural and paleontological resources. Requirement/Standard: Lessees shall conduct a cultural and paleontological resources survey prior to any ground-disturbing activity. Upon finding any potential cultural or paleontological resource, the lessee or their designated representative shall notify the AO and suspend all operations in the immediate area of such discovery until written authorization to proceed is issued by the AO.	***ROP E-13: Protections for Cultural Resources*** Objective: Protect cultural and paleontological resources. Requirement/Standard: Permittees shall conduct a cultural (as required by 36 CFR 800.4 and AS 41.35.070) and paleontological resources survey prior to any ground-disturbing activity begins. Primary investigators overseeing cultural surveys must meet the Secretary of the Interior's professional qualification standards for qualified professional archaeologists (36 CFR 61, Appendix A). Upon discovering a potentially undocumented cultural or paleontological resource, the permittee or their designated representative shall notify the AO and suspend all operations in the immediate area of the discovery until the AO issues a written authorization to proceed. Permittees shall avoid known cultural and paleontological sites by a minimum of 500 feet from the site boundary.
BMP E-14 Objective: Ensure the passage of fish at stream crossings. Requirement/Standard: To ensure that crossings provide for fish passage, all proposed crossing designs shall adhere to the BMPs outlined in Stream Crossing Design Procedure for Fish Streams on the North Slope Coastal Plain (McDonald et al. 1994), Fundamentals of Culvert Design for Passage of Weak-Swimming Fish (Behlke et al. 1991), and other generally accepted BMPs prescribed by the AO. To adhere to these BMPs, at least 3 years of hydrologic and fish data shall be collected by the lessee for any proposed crossing of a stream whose structure is designed to occur, wholly or partially, below the stream's ordinary high watermark. These data shall include, but are not limited to, the range of water levels (highest and lowest) at the location of the planned crossing and the seasonal distribution and composition of fish populations using the stream.	The similar requirement is **ROP E-6**, which combines **BMPs E-6** and **E-14**.
BMP E-15 Objective: Prevent or minimize the loss of nesting habitat for cliff-nesting raptors. Requirement/Standard: a. Removal of greater than 100 cubic yards of bedrock outcrops, sand, and/or gravel from cliffs shall be prohibited. b. Any extraction of sand and/or gravel from an active river or stream channel shall be prohibited unless preceded by a hydrological study that indicates no potential impact by the action to the integrity of the river bluffs.	The similar requirement is incorporated into **ROP E-8**.
BMP E-16 Objective: Prevent or minimize the loss of raptors due to electrocution by power lines. Requirement/Standard: Comply with the most up-to-date, industry-accepted suggested practices for raptor protection on power lines. Current accepted standards were published in *Reducing Avian Collisions with Power Lines: The State of the Art in 2012* by the Avian Power Line Interaction Committee and are updated as needed.	***ROP E-16: Power Line Design*** Objective: Prevent or minimize the loss of raptors due to electrocution by power lines. Requirement/Standard: Comply with the most up-to-date, industry-accepted suggested practices for raptor protection on power lines. Current accepted standards were published in the most recent Avian Power Line Interaction Committee suggested practices (currently 2012). See **ROP E-21** for additional requirements to reduce impacts on birds from utility lines and communication towers.
BMP E-17 Objective: Manage permitted activities to meet Visual Resource Management class objectives described below. Class I: Natural ecological changes and very limited management activity are allowed. The level of change to the characteristic landscape should be very low and must not attract attention. Class II: The level of change to the characteristic landscape should be low. Management activities may be seen but should not dominate the view of the casual observer. Any changes should repeat the basic elements of form, line, color, and texture found in the predominant natural features of the characteristic landscape. Class III: The level of change to the characteristic landscape should be moderate. Management activities may attract attention but should not dominate the view of the casual observer. Changes should repeat the basic elements found in the predominant natural features of the characteristic landscape. Class IV: The level of change to the characteristic landscape can be high. These management activities may dominate the view and be the major focus of viewer attention; however, every attempt should be made to minimize impacts through location and design by repeating form, line, color, and texture. Requirement/Standard: At the time of application for construction of permanent facilities, the lessee/permittee shall, after consultation with the AO, submit a plan to best minimize visual impacts, consistent with the Visual Resource Management class for the lands on which facilities would be located. A photo simulation of the proposed facilities may be a necessary element of the plan.	***ROP E-17: Visual Resources Management*** Objective: Manage permitted activities to meet Visual Resource Management class objectives. Requirement/Standard: At the time of application for construction of permanent facilities, the permittee, after consultation with the AO, shall submit a plan for approval by the AO to best minimize visual impacts, consistent with the Visual Resource Management class for the lands on which facilities would be located. A photo simulation of the proposed facilities may be a necessary element of the plan. Visual Resource Management Classes (see **Table 2-1** for actual acreages within each class by alternative): • Visual Resource Management Class II—Wainwright Inlet and those areas where new infrastructure is not allowed • Visual Resource Management Class III—Except for those areas designated as Visual Resource Management II, rivers and lands within 3 miles of segments of rivers identified as eligible for Wild and Scenic Rivers designation; also Kasegaluk Lagoon, Peard Bay, Elson Lagoon, Dease Inlet, and Admiralty Bay and lands within 3 miles of those waterbodies • Visual Resource Management Class IV—The rest of the NPR-A

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Visual Resource Management Classes (see **Table 2-1** for actual acreages within each class, by alternative): • Visual Resource Management Class II—Wainwright Inlet and those areas where new infrastructure is not allowed • Visual Resource Management Class III—Except for those areas designated as Visual Resource Management II, rivers and lands within 3 miles of segments of rivers identified as eligible for Wild and Scenic Rivers designation in the 2013 IAP, the 2003 Northwest NPR-A IAP, or the 2008 Northeast NPR-A Supplemental IAP; also Kasegaluk Lagoon, Peard Bay, Elson Lagoon, Dease Inlet, and Admiralty Bay and lands within 3 miles of those waterbodies • Visual Resource Management Class IV—The rest of the NPR-A	*(see above)*
BMP E-18 Objective: Avoid and reduce temporary impacts on productivity from disturbance near Steller's and/or spectacled eider nests. Requirement/Standard: Ground-level activity (by vehicle or on foot) within 200 meters of occupied Steller's and/or spectacled eider nests, from June 1 through August 15, would be restricted to existing thoroughfares, such as pads and roads. Construction of permanent facilities, placement of fill, alteration of habitat, and introduction of high noise levels within 200 meters of occupied Steller's and/or spectacled eider nests would be prohibited. In instances where summer (June 1 through August 15) support/construction activity must occur off existing thoroughfares, USFWS-approved nest surveys must be conducted during mid-June prior to the approval of the activity. Collected data would be used to evaluate whether the action could occur, based on deployment of a 200-meter buffer around nests or if the activity would be delayed until after mid-August, once ducklings are mobile and have left the nest site. Also, in cases in which oil spill response training is proposed to be conducted within 200 meters of shore in riverine, marine, or inter-tidal areas, the BLM would work with the USFWS to schedule the training at a time that is not a sensitive nesting/brood-rearing period or require that nest surveys be conducted in the training area prior to the rendering a decision on approving the training. The protocol and timing of nest surveys for Steller's and/or spectacled eiders would be determined in cooperation with the USFWS and must be approved by the USFWS. Surveys should be supervised by biologists who have previous experience with Steller's and/or spectacled eider nest surveys.	***ROP E-18: Protection for Steller's and Spectacled Eiders*** Objective: Avoid and reduce temporary impacts on productivity from disturbance near Steller's and spectacled eider nests within the Barrow Triangle area. Requirement/Standard: Ground-level activity (by vehicle or on foot) within 660 feet of occupied Steller's or spectacled eider nests, from June 1 through July 31, would be restricted to existing thoroughfares, such as pads and roads. Construction of permanent facilities, placement of fill, alteration of habitat, and introduction of high noise levels within 660 feet of occupied Steller's or spectacled eider nests would be prohibited. In instances where summer support/construction activity must occur off existing thoroughfares from June 1 through July 31, USFWS-approved nest surveys must be conducted during mid-June prior to the BLM approval of the activity. Collected data would be used to evaluate whether the action could occur, based on deployment of a 660-foot buffer around nests or if the activity would be delayed until after mid-August, once ducklings are mobile and have left the nest site. In cases in which oil spill response training is proposed to be conducted within 660 feet of shore in riverine, marine, or inter-tidal areas, the BLM would work with the USFWS to schedule the training at a time that is not a sensitive nesting/brood-rearing period, or require that nest surveys be conducted in the training area prior to the BLM rendering a decision on approving the training. The protocol and timing of nest surveys for Steller's or spectacled eiders would be determined in cooperation with the USFWS and must be approved by the USFWS. Surveys should be supervised by biologists who have previous experience with Steller's or spectacled eider nest surveys. Applicants are encouraged to work outside the eider nesting window throughout the NPR-A, particularly in areas with higher densities of listed eiders. Where work must take place during the nesting period, an evaluation should be conducted, pursuant to Section 7 of the Endangered Species Act, to determine if adverse effects are likely to occur. This analysis could be conducted as part of consultation on proposed development projects prior to permitting or using a programmatic approach for ground activities, including spill response training and equipment staging, where these are evaluated and authorized annually, as needed.
BMP E-19 Objective: Provide information to be used in monitoring and assessing wildlife movements during and after construction. Requirement/Standard: A representation, in the form of ArcGIS-compatible shape-files of all new infrastructure construction shall be provided to the AO. During the planning and permitting phase, shape-files representing proposed locations shall be provided. Within 6 months of construction completion, shape-files, within GPS accuracy, of all new infrastructure shall be provided. Infrastructure includes all gravel roads and pads, facilities built on pads, pipelines, and independently constructed power lines (as opposed to those incorporated in pipeline design). Gravel pads shall be included as polygon feature. Roads, pipelines, and power lines may be represented as line features but must include ancillary data to denote width, number pipes, etc. Poles for power lines may be represented as point features. Ancillary data shall include construction beginning and ending dates.	***ROP E-19: GIS Files for Proposed Infrastructure*** Objective: Provide information to be used in monitoring and assessing wildlife movements during and after construction. Requirement/Standard: The operator will provide to the BLM AO, the State of Alaska, and the NSB, a representation in the form of ArcGIS-compatible shapefiles of the footprint of all new infrastructure construction. During the planning and permitting phase, the contractor would provide GIS shape files of proposed footprint locations. Within 6 months of construction completion, shapefiles of all new infrastructure footprints also would be provided. Infrastructure includes all gravel roads and pads, facilities built on pads, pipelines, and independently constructed power lines (as opposed to those incorporated in pipeline design). Gravel pads would be included as polygon features. Roads, pipelines, and power lines may be represented as line features but must include ancillary data to denote such data as width and number of pipes. Poles for power lines may be represented as point features. Ancillary data will include construction beginning and ending dates.
Required by the 2008 Colville River Special Area Management Plan.	***ROP E-20: Protections for Nesting Falcons*** Objective: Minimize disturbance to nesting falcons Requirement/Standard: Off road foot or vehicle traffic, construction and non-emergency hazardous material or solid waste cleanup shall be prohibited within one mile of known arctic peregrine and gyrfalcon nests from April 15-August 15. Non-emergency cleanup refers to remediation of old sites, such as removal of drums or soil that has been contaminated for longer than one season.
See **BMP E-11**.	***ROP E-21: Aboveground Utility Design*** Objective: Minimize the impacts on bird species from direct interaction with aboveground utility infrastructure. Requirement/Standard: a. To reduce the possibility of birds colliding with aboveground utility lines (power and communication), such lines would either be buried in access roads or would be suspended on vertical support members, except in rare cases, limited in extent. Exceptions are limited to the following situations: • Overhead power or communication lines may be allowed when located entirely within the boundaries of a facility pad. • Overhead power or communication lines may be allowed when engineering constraints at the specific and limited location make it infeasible to bury or connect the lines to a vertical support member. • Overhead power or communication lines may be allowed in situations when human safety would be compromised by other methods. b. To reduce the likelihood of birds colliding with them, communication towers would be located, to the extent practicable, on existing

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	pads and as close as possible to buildings or other structures and on the east or west side of buildings or other structures, if possible. Support wires associated with communication towers, radio antennas, and other similar facilities would be avoided to the extent practicable. If support wires are necessary, they would be clearly marked along their entire length to improve visibility to low-flying birds. Such markings would be developed through consultation with the USFWS. c. Design of other utility infrastructure, such as wind turbines, would be evaluated under a specific development proposal.
Required by the 2008 Colville River Special Area Management Plan.	***ROP E-22: Campsites in Raptor Habitat*** Objective: Minimize disturbance impacts on nesting arctic peregrine falcons. Requirement/Standard: a. To reduce disturbance from campsite activity to nesting arctic peregrine falcons, campsites authorized by BLM, including short- and long-term camps and agency work camps, shall be located at least 500 meters from any known arctic peregrine falcon nest site. Exceptions may be granted by the AO on a case-by-case basis. b. All users authorized by BLM, including BLM and other agency personnel, shall submit for approval an operational plan that includes dates, locations, and schedule of visits to cliff sites, when dates are between April 15 and August 15. The cumulative number of authorized visits (defined as each day in which work is done within 500 meters of a nest site) to any cliff per nesting season (April 15 through August 15) by all authorized users shall be limited to three. Exceptions may be granted if the detailed operations plan documents why the necessary work could be done no other way. Raptor biologists must coordinate their activities with the BLM, the USFWS, the Alaska Department of Fish and Game, and the NSB. Lessees shall follow the guidelines for conducting activities near arctic peregrine falcon nests. Exceptions to this requirement may be granted when necessary to conduct certain studies.
No similar requirement.	***ROP E-23: Infrastructure Siting Near Teshekpuk Lake*** Objective: Mitigate the impacts of permanent infrastructure on caribou movement near Teshekpuk Lake. Requirement/Standard: Prior to the permitting of permanent infrastructure within the TCH Habitat Area (the 75% calving caribou kernel), a workshop shall be convened to identify the optimal placement of infrastructure to minimize impacts on caribou, birds, and other wildlife. The workshop participants shall include but will not be limited to Federal, state, and NSB representatives.
F. Use of Aircraft for Permitted Activities	
BMP F-1 Objective: Minimize the effects of low-flying aircraft on wildlife, subsistence activities, and local communities. Requirement/Standard: The lessee shall ensure that aircraft used for permitted activities maintain altitudes according to the following guidelines. (Note: this BMP is not intended to restrict flights necessary to survey wildlife to gain information necessary to meet the stated objectives of the stipulations and BMPs; however, flights necessary to gain this information will be restricted to the minimum necessary to collect such data.) a. Aircraft shall maintain an altitude of at least 1,500 feet above ground level when within 0.5 miles of cliffs identified as raptor nesting sites from April 15 through August 15 and an altitude of at least 1,500 feet above ground level when within 0.50 miles of known gyrfalcon nest sites from March 15 to August 15, unless doing so would endanger human life or violate safe flying practices. Permittees shall obtain information from the BLM necessary to plan flight routes when routes may go near falcon nests. b. Aircraft shall maintain an altitude of at least 1,000 feet above ground level (except for takeoffs and landings) over caribou winter ranges from December 1 through May 1, unless doing so would endanger human life or violate safe flying practices. The AO would authorize caribou wintering areas annually. The BLM would consult directly with the Alaska Department of Fish and Game in defining caribou winter ranges. c. Land users shall submit an aircraft use plan as part of an oil and gas exploration or development proposal. The plan shall address strategies to minimize impacts on subsistence hunting and associated activities, including but not limited to the number of flights, type of aircraft, and flight altitudes and routes, and shall also include a plan to monitor flights. d. Proposed aircraft use plans should be reviewed by appropriate federal, State, and borough agencies. Consultations with these same agencies would be required if unacceptable disturbance is identified by subsistence users. Adjustments, including possible suspension of all flights, may be required by the AO if resulting disturbance is determined to be unacceptable. e. The number of takeoffs and landings to support oil and gas operations with necessary materials and supplies should be limited to the maximum extent possible. During the design of proposed oil and gas facilities, larger landing strips and storage areas should be considered to allow larger aircraft to be employed, resulting in fewer flights to the facility. f. Use of aircraft, especially rotary wing aircraft, near known subsistence camps and cabins or during sensitive subsistence hunting periods (spring goose hunting and fall caribou and moose hunting) should be kept to a minimum. g. Aircraft used for permitted activities shall maintain an altitude of at least 2,000 feet above ground level (except for takeoffs and landings) over the TCH Habitat Area (**Appendix A**, **Map 2-1 and Map 2-2**) from May 20 through August 20, unless doing so would endanger human life or violate safe flying practices. Aircraft use (including fixed-wing and helicopter) by oil and gas lessees in the Goose Molting Area (**Appendix A**, **Map 2-1 and 2-2**) should be minimized from May 20 through August 20, unless doing so would endanger human life or violate safe flying practices. h. Aircraft used for permitted activities shall maintain an altitude of at least 2,000 feet above ground level (except for takeoffs and landings) over the Utukok River Uplands Special Area (**Appendix A**, **Map 2-1 and Map 2-2**) from May 20 through August 20, unless doing so would endanger human life or violate safe flying practices.	See separate **ROPs F-2** through **F-4** below.

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i. Hazing of wildlife by aircraft is prohibited. Pursuit of running wildlife is hazing. If wildlife begins to run as an aircraft approaches, the aircraft is too close and must break away. j. fixed-wing aircraft used as part of a BLM-authorized activity along the coast shall maintain minimum altitude of 2,000 feet when within a 0.5 miles of walrus haul-outs, unless doing so would endanger human life or violate safe flying practices. Helicopters used as part of a BLM-authorized activity along the coast shall maintain minimum altitude of 3,000 feet and a 1-mile buffer from walrus haul-outs, unless doing so would endanger human life or violate safe flying practices. k. Aircraft used as part of a BLM-authorized activity along the coast and shore fast-ice zone shall maintain a minimum altitude of 3,000 feet when within 1 mile of aggregations of seals, unless doing so would endanger human life or violate safe flying practices.	*(see above)*
See **BMP F-1** above.	***ROP F-2: Aircraft Use Plan*** Objective: Provide aviation data required for management, for Endangered Species Act consultation with USFWS and National Marine Fisheries Service, and to minimize impacts on subsistence activities and wildlife. Requirement/Standard: Permittees shall submit an aircraft use plan 60 days prior to activities. Projects with landings north of 70 degrees North latitude that will occur between June 1 and October 15 must submit estimates of takeoffs and landings no later than April 5. The plan shall include the following elements: a. Following wildlife with aircraft is prohibited. Particular attention would be given to avoid disturbing caribou. b. The number of anticipated flights, as defined by a single takeoff and landing. The number of takeoffs and landings should be limited to the maximum extent practicable. During the design of proposed infrastructure projects, larger landing strips and storage areas should be considered to allow the use of larger aircraft. c. Types of aircraft, including pictures and tail numbers of aircraft (as early as possible), d. Flight altitudes and routes. e. Methods of monitoring and reporting flights. f. The aircraft use plan may also include an aircraft monitoring plan. The AO may require adjustments to the aircraft use plan, based on the results of the monitoring. g. Strategies to comply with **ROPs F-3, F-4, K-6, K-8, K-9 and K-14,** as applicable**.**
See **BMP F-1** above; also required by the 2008 Colville River Special Area Management Plan.	***ROP F-3: Minimum Flight Altitudes*** Objective: Minimize the effects of low-flying aircraft on wildlife, subsistence activities, and local communities. Requirement/Standard: Aircraft flights for permitted activities (fixed-wing and helicopters, unless specified), except for takeoffs and landings, shall maintain the following minimum altitudes above ground level during the dates and in the areas defined, unless doing so would endanger human life or violate safe flying practices or if the purpose of the flight requires constant sight of the ground, such as sight of permitted wildlife or for archaeological or engineering survey flights or ice road planning and cleanup: • April 15–August 15—1,500 feet within 0.5 miles of cliffs identified as raptor nesting sites. • March 15–August 15—1,500 feet within 0.5 miles of known gyrfalcon nest sites. • May 20–August 20—All aircraft use in the Goose Molting Area should be minimized. • December 1–May 1—1,500 feet over caribou winter ranges. • May 20–August 20—1,500 feet over the TCH Habitat Area and over the Utukok River Uplands Special Area. • Fixed wing—2,000 feet when within 0.5 miles of walrus haul-outs. • Helicopters—3,000 feet and a 1-mile buffer from walrus haul-outs. • Aircraft—3,000 feet when within 1-mile of aggregations of seals. The BLM will provide maps and data of the areas listed above.
See **BMP F-1** above.	***ROP F-4: Reduce Impacts of Air Traffic on Subsistence Resources*** Objective: To reduce the impacts of aircraft traffic on North Slope subsistence hunters. Requirement/Standard: a. Hazing of wildlife by aircraft is prohibited. Pursuit of running wildlife is hazing. If wildlife begins to run as an aircraft approaches, the aircraft is too close and must break away. • Nonessential helicopter flights would be suspended during peak caribou hunting within 2 miles of heavily used subsistence rivers* or helicopter traffic during this time would be limited to flight corridors that minimize impact (e.g., perpendicular crossings upstream of cabins). The current suspension dates are July 15 through August 15. Suspension dates may be revised every 3 years upon review of peak caribou season, in consultation with affected communities and the NSB Department of Planning and Department of Wildlife Management. Ongoing (multi-year, already planned) scientific/environmental studies that depend on access to study sites that are already planned could continue if there is no alternative access to sites. b. Minimize aircraft use near known subsistence camps and cabins and during sensitive subsistence hunting periods (spring goose hunting summer and fall caribou and moose hunting) by adhering to the following guidelines: • Arrange site visits and flight schedules to conduct required activity near subsistence areas early in the season, on weekdays, and as early in the morning as possible; avoid holidays. • Note whether activities overlap heavily used subsistence rivers and determine if a potentially affected community's tribal or city office should be notified.

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(see above)	• Compare the proposed landing sites with the NSB camps and cabins map or Google Earth .kmz file available from the BLM Arctic Office. If activities near camps or allotments cannot be avoided, contact the camp or allotment owner to discuss the timing of the visit. *Heavily used subsistence rivers are as follows: • Colville, Ublutuoch, Fish and Judy creeks (Nuiqsut) • Utukok, Kokolik, Kukpowruk (Point Lay) • Kuk and tributaries (Kaolak, Ketik, Avalik, Ivisaruk, Kungok), Kugrua (Wainwright) • Meade, Niġisaktugvik, Isiqtuq (Atqasuk) • Inaru, Topagaruk, Chipp, Ikpikpuk, Miguakiak, Piasuk (Utqiaġvik)
G. Oil and Gas Field Abandonment	
Lease Stipulation G-1 Objective: Ensure long-term reclamation of land to its previous condition and use. Requirement/Standard: Prior to final abandonment, land used for oil and gas infrastructure—including but not limited to well pads, production facilities, access roads, and airstrips—shall be reclaimed to ensure eventual restoration of ecosystem function. The leaseholder shall develop and implement an abandonment and reclamation plan approved by the BLM. The plan shall describe short-term stability, visual, hydrological, and productivity objectives and steps to be taken to ensure eventual ecosystem restoration to the land's previous hydrological, vegetative, and habitat condition. The BLM may grant exceptions to satisfy stated environmental or public purposes.	***ROP G-1: Reclamation of BLM-Managed Land*** Objective: Ensure long-term reclamation of land. Requirement/Standard: Prior to final abandonment, land used for oil and gas infrastructure—including but not limited to well pads, production facilities, access roads, and airstrips—shall be reclaimed to ensure eventual restoration of ecosystem function. The leaseholder shall develop and implement an abandonment and reclamation plan approved by the BLM. The plan shall describe short-term stability, visual, hydrological, and productivity objectives and steps to be taken to ensure eventual ecosystem restoration to the land's previous hydrological, vegetative, and habitat condition. The BLM may grant exceptions to satisfy stated environmental purposes or community needs. See **ROP M-5** for additional requirements to reduce areas of bare soil.
H. Subsistence Consultation for Permitted Activities	
BMP H-1 Objective: Provide opportunities for participation in planning and decision making to prevent unreasonable conflicts between subsistence uses and other activities. Requirement/Standard: The lessee/permittee shall consult directly with affected communities using the following guidelines: a. Before submitting an application to the BLM, the applicant shall consult with directly affected subsistence communities, the NSB, and the NPR-A Subsistence Advisory Panel to discuss the siting, timing, and methods of their proposed operations. This would be done to help discover local traditional and scientific knowledge, resulting in measures that minimize impacts on subsistence uses. Through this consultation, the applicant shall make every reasonable effort, including such mechanisms as conflict avoidance agreements and mitigating measures, to ensure that proposed activities would not result in unreasonable interference with subsistence activities. In the event that no agreement is reached between the parties, the AO shall consult with the directly involved parties and determine which activities would occur, including the time frames. b. The applicant shall submit documentation of consultation efforts as part of their operations plan. Applicants should submit the proposed plan of operations to the NPR-A Subsistence Advisory Panel for review and comment. The Applicant must allow time for the BLM to conduct formal government-to-government consultation with Native tribal governments if the proposed action requires it. c. A plan shall be developed that shows how the activity, in combination with other activities in the area, would be scheduled and located to prevent unreasonable conflicts with subsistence activities. The plan would also describe the methods used to monitor the effects of the activity on subsistence use. The plan shall be submitted to the BLM as part of the plan of operations. The plan should address the following items: • A detailed description of the activities to take place, including the use of aircraft. • A description of how the lessee/permittee would minimize or deal with any potential impacts identified by the AO during the consultation process. • A detailed description of the monitoring effort to take place, including process, procedures, personnel involved, and points of contact, both at the work site and in the local community. • Communication elements to provide information on how the applicant would keep potentially affected individuals and communities up to date on the progress of the activities and locations of possible, short-term conflicts (if any) with subsistence activities; communication methods could include holding community meetings, open house meetings, workshops, newsletters, radio and television announcements, etc. • Procedures necessary to facilitate access by subsistence users to the permittees' area of activity or facilities during the course of conducting subsistence activities. d. During development, monitoring plans must be established for new permanent facilities, including pipelines, to assess an appropriate range of potential effects on resources and subsistence as determined on a case-by-case basis given the nature and location of the facilities. The scope, intensity, and duration of such plans shall be established in consultation with the AO and NPR-A Subsistence Advisory Panel. e. Permittees that propose barging facilities, equipment, supplies, or other materials to NPR-A in support of oil and gas activities in the NPR-A shall notify, confer, and coordinate with the Alaska Eskimo Whaling Commission, the appropriate local community,	***ROP H-1: Subsistence Plan*** Objective: Prevent unreasonable conflicts with subsistence. Requirement/Standard: Projects that would occur within 50 miles of a community or fewer than 15 miles from the heavily used subsistence rivers listed in **ROP F-4** shall submit a subsistence plan. The plan should be submitted as early as possible and no later than an application is submitted to BLM. The plan will include: a. A brief summary of the proposed activity, focusing on details relevant to subsistence, including the use of aircraft. b. A description of how the activity, in combination with other activities in the area, would be scheduled and located to prevent conflicts with subsistence activities. c. Procedures to facilitate access by subsistence users to the permittees' area of activity or appropriate facilities. d. A description of how the permittee would address potential subsistence issues. e. An explanation of how the activity's effects on subsistence activities would be documented and how that documentation would be made available. f. The names and contact information for subsistence representatives, project points of contact, and community liaisons. (This information should be available by the time an application is submitted to the BLM. If this information is not available when the plan is produced, the plan will include the date that it would be available, and explain how the applicant would make that information available.) g. A description of how the plan would be updated if necessary during the course of review and consultation. h. Information on how the applicant would keep potentially affected individuals and communities up to date on the progress of the activities and locations of possible, short-term conflicts with subsistence activities; such communication methods could include posting information on a website and distributing the link; social media; newsletters and radio and television announcements; community meetings; or workshops.

Alternative A	Alternatives B, C, and D
whaling captains associations, and the NSB to minimize impacts from the proposed barging on subsistence whaling activities. i. Barge operators requiring a BLM permit are required to demonstrate that barging activities will not have unmitigable adverse impacts on the availability of marine mammals to subsistence hunters. j. All vessels over 50 feet in length engaged in operations requiring a BLM permit must have an automatic identification system transponder system on the vessel.	*(see above)*
BMP H-2 Objective: Prevent unreasonable conflicts between subsistence activities and geophysical (seismic) exploration. Requirement/Standard: In addition to the consultation process described in BMP H-1 for permitted activities, before activity to conduct geophysical (seismic) exploration commences, applicants shall notify the local search and rescue organizations of proposed seismic survey locations for that operational season. For the purpose of this standard, a potentially affected cabin/campsite is defined as any camp or campsite used for subsistence purposes and located within the boundary of the area subject to proposed geophysical exploration and/or within 1 mile of actual or planned travel routes used to supply the seismic operations while it is in operation. a. Because of the large land area covered by typical geophysical operations and the potential to impact a large number of subsistence users during the exploration season, the permittee/operator shall notify all potentially affected subsistence-use cabin and campsite users. b. The official recognized list of subsistence-use cabin and campsite users is the NSB's most current inventory of cabins and campsites, which have been identified by the subsistence users' names. c. A copy of the notification, a map of the proposed exploration area, and the list of potentially affected users shall also be provided to the office of the appropriate native tribal government. d. The AO would prohibit seismic work within 1 mile of any known subsistence-use cabin or campsite, unless an alternative agreement between the cabin/campsite owner/user is reached through the consultation process and presented to the AO. (Regardless of the consultation outcome, the AO would prohibit seismic work within 300 feet of a known subsistence-use cabin or campsite.) e. The permittee shall notify the appropriate local search and rescue (e.g., Nuiqsut Search and Rescue, Atqasuk Search and Rescue) of their current operational location within the NPR-A on a weekly basis. This notification should include a map indicating the current extent of surface use and occupation, as well as areas previously used/occupied during the course of the operation in progress. The purpose of this notification is to allow hunters up-to-date information regarding where seismic exploration is occurring, and has occurred, so that they can plan their hunting trips and access routes accordingly. Identification of the appropriate search and rescue offices to be contacted can be obtained from the coordinator of the NPR-A Subsistence Advisory Panel in the BLM's Arctic Field Office.	***ROP H-2: Consultation Requirements for Seismic Exploration*** Objective: Prevent conflicts between geophysical (seismic) exploration and subsistence areas. Requirement/Standard: Applicants conducting geophysical (seismic) exploration shall: a. Notify and consult individually with all potentially affected allotment, camp, and cabin owners. - The official recognized list of subsistence-use cabins and campsite users is the NSB's most current inventory of cabins and campsites, which have been identified by the subsistence users' names. - For the purpose of this standard, a potentially affected site is defined as any allotment or camp or campsite located within the boundaries of the area proposed for geophysical exploration or within 1 mile of travel routes used to supply seismic operations. - The AO would prohibit seismic work within 1 mile of these sites, unless an alternative agreement between the site owner/user is reached through the consultation process and presented to the AO. Regardless of the consultation outcome, the AO would prohibit seismic work within 300 feet of a known subsistence-use cabin or campsite. - Provide local search and rescue organizations with proposed seismic survey locations before the operational season and, during operations, of current location on a weekly basis; this notification should include a map indicating the current extent of surface use and occupation and areas previously used and occupied during the course of the operation; this would enable hunters to plan their hunting trips and access routes accordingly.
BMP H-3 Objective: Minimize sport hunting and trapping species and to subsistence harvest of those animals. Requirement/Standard: Hunting and trapping by lessee's/permittee's employees, agents, and contractors are prohibited when persons are on "work status." Work status is defined as the period during which an individual is under the control and supervision of an employer. Work status is terminated when the individual's shift ends and he/she returns to a public airport or community (e.g., Fairbanks, Utqiaġvik, Nuiqsut, or Deadhorse). Use of lessee/permittee facilities, equipment, or transport for personal access or aid in hunting and trapping is prohibited.	***ROP H-3: Hunting, Fishing, and Trapping by Permittees*** Objective: Minimize impacts on hunting, trapping, and fishing species and to subsistence harvest of those animals consistent with requirements of the Alaska National Interest Lands Conservation Act. Requirement/Standard: Hunting, trapping, and fishing by the permittee's employees, agents, and contractors is prohibited when persons are on "work status." Work status is defined as the period during which an individual is under the control and supervision of an employer. Work status is terminated when the individual's shift ends and he/she returns to a public airport or community (e.g., Fairbanks, Utqiaġvik, Nuiqsut, or Deadhorse). Use of permittee facilities, equipment, or transport for personal access or aid in hunting, trapping, and fishing is prohibited.
No similar requirement. See **H-1** for a similar requirement.	***ROP H-4: Notification and Consultation with Alaska Native Groups*** Objective: Prevent unreasonable conflicts with subsistence access and activities by providing opportunities for consultation and incorporating input into project plans. Requirement/Standard: For projects that require a subsistence plan (H-1), permittees shall prevent unreasonable conflicts with subsistence access, use areas, and schedules by facilitating consultation according to the following guidelines: a. Permittee shall provide affected communities early and adequate notice of proposed activities. - Applicants shall submit the complete subsistence plan (H-1) and the proposed plan of operation (or summary thereof) to appropriate North Slope entities at the earliest possible date (and no later than when an application is submitted to the BLM) to allow time for the North Slope entities to determine if the proposed action warrants further consultation. b. Permittees shall provide opportunities for affected communities to participate in planning and decision-making and shall solicit and incorporate as possible local input on the siting, timing, and methods of the proposed operations. Permittees shall present proposed activities to North Slope entities and to individual tribes and ANCSA corporations as requested. Through this consultation, the applicant shall make every reasonable effort, including such mechanisms as conflict avoidance agreements and mitigating measures, to ensure that proposed activities would not result in unreasonable interference with subsistence activities. - On any emailed meeting announcements, applicants should carbon copy the BLM. - For meetings announced by flyers or other means, the permittee should notify the BLM by email. - Permittees shall provide the BLM with a copy of meeting notes within one month of the meeting date for all meetings held pursuant to their subsistence plan required in **ROP H-1**. c. Permittees that propose barging equipment or supplies to the NPR-A shall notify and coordinate with the Alaska Eskimo Whaling Commission and the appropriate local community whaling captains associations.

Alternative A	Alternatives B, C, and D
No similar requirement.	***ROP H-5: Public Availability of Environmental Data*** Objective: Make data and summary reports derived from North Slope studies easily accessible. Requirement/Standard: Permittees shall submit reports related to permitted activity or required monitoring studies on BLM-managed land. Reports shall be submitted within 2 months of finalization to the BLM Arctic District Office to be posted online. At a minimum, permittees would include all reports related to studies that pertain to the environment on BLM-managed land. Permittees are encouraged to make other research relevant to the community (research on non-federal land, etc.) accessible in the same manner. All data collected by the permittee that is required by the BLM must be submitted to the BLM in a GIS format (ESRI shapefiles referencing the North American Datum of 1983) and be available to the public. Exceptions can be granted for particularly sensitive types of data (e.g. cultural sites and radio-collar locations).
I. Orientation Programs Associated with Permitted Activities	
BMP I-1 Objective: Minimize cultural and resource conflicts. Requirement/Standard: All personnel involved in oil and gas and related activities shall be provided information concerning applicable stipulations, BMPs, standards, and specific types of environmental, social, traditional, and cultural concerns that relate to the region. The lessee/permittee shall ensure that all personnel involved in permitted activities shall attend an orientation program at least once a year. The proposed orientation program shall be submitted to the AO for review and approval and should: a. Provide sufficient detail to notify personnel of applicable stipulations and BMPs as well as inform individuals working on the project of specific types of environmental, social, traditional and cultural concerns that relate to the region. b. Address the importance of not disturbing archaeological and biological resources and habitats, including endangered species, fisheries, bird colonies, and marine mammals, and provide guidance on how to avoid disturbance. c. Include guidance on the preparation, production, and distribution of information cards on endangered and/or threatened species. d. Be designed to increase sensitivity and understanding of personnel to community values, customs, and lifestyles in areas in which personnel would be operating. e. Include information concerning avoidance of conflicts with subsistence, commercial fishing activities, and pertinent mitigation. f. Include information for aircraft personnel concerning subsistence activities and areas/seasons that are particularly sensitive to disturbance by low-flying aircraft; of special concern is aircraft use near traditional subsistence cabins and campsites, flights during spring goose hunting and fall caribou and moose hunting seasons, and flights near North Slope communities. g. Provide that individual training is transferable from one facility to another, except for elements of the training specific to a particular site. h. Include on-site records of all personnel who attend the program for so long as the site is active, though not to exceed the 5 most recent years of operations; this record shall include the names and dates(s) of attendance of each attendee. i. Include a module discussing bear interaction plans to minimize conflicts between bears and humans. j. Provide a copy of 43 CFR 3163 regarding Non-Compliance Assessment and Penalties to on-site personnel. k. Include training designed to ensure strict compliance with local and corporate drug and alcohol policies; this training should be offered to the NSB Health Department for review and comment. l. Include training developed to train employees on how to prevent transmission of communicable diseases, including sexually transmitted diseases, to the local communities; this training should be offered to the NSB Health Department for review and comment.	***ROP I-1: Employee Orientation Program*** Objective: Same as Alternative A. Requirement/Standard: All personnel involved in permitted activities shall be provided with information concerning applicable stipulations, ROPs, standards, and specific types of environmental, social, traditional, and cultural concerns that relate to the region. The permittee shall ensure that all personnel involved in permitted activities shall attend an orientation program at least once a year. The proposed orientation program shall be submitted to the AO for review and approval and should: a. Provide sufficient detail to notify personnel of applicable stipulations and ROPs as well as inform individuals working on the project of specific types of environmental, social, traditional, and cultural concerns that relate to the region. b. Address the importance of not disturbing archaeological, paleontological, and biological resources and habitats, including endangered species, fisheries, bird colonies, and marine mammals, and provide guidance on how to avoid disturbance. c. Include guidance on the preparation, production, and distribution of information cards on endangered and/or threatened species. d. Be designed to increase sensitivity and understanding of personnel to community values, customs, and lifestyles in areas in which personnel would be operating. e. Include information concerning avoidance of conflicts with subsistence, commercial fishing activities, and pertinent mitigation. f. Include information for aircraft personnel concerning subsistence activities and areas/seasons that are particularly sensitive to disturbance by low-flying aircraft; of special concern is aircraft use near traditional subsistence cabins and campsites, flights during spring goose hunting and fall caribou and moose hunting seasons, and flights near North Slope communities. g. Provide that individual training is transferable from one facility to another, except for elements of the training specific to a particular site. h. Include on-site records of all personnel who attend the program for as long as the site is active, though not to exceed the 5 most recent years of operations. This record shall include the name and dates(s) of attendance of each attendee. i. Include a module discussing bear interaction plans to minimize conflicts between bears and human. j. Provide a copy of 43 CFR 3163 regarding Non-Compliance Assessment and Penalties to on-site personnel. k. Include training designed to ensure strict compliance with local and corporate drug and alcohol policies. This training should be offered to the NSB Health Department for review and comment.
K. Additional Protections that Apply in Select Biologically Sensitive Areas	
See **Table 2-3**.	See **Table 2-3**.
L. Summer Vehicle Tundra Access	
BMP L-1 Objective: Protect stream banks and water quality; minimize compaction and displacement of soils; minimize the breakage, abrasion, compaction, or displacement of vegetation; protect cultural and paleontological resources; maintain populations of and adequate habitat for birds, fish, and caribou and other terrestrial mammals; and minimize impacts on subsistence activities. Requirement/Standard: On a case-by-case basis, the BLM may permit low-ground-pressure vehicles to travel off of gravel pads and roads during times other than those identified in BMP C-2a. Permission for such use would only be granted after an applicant has: a. Submitted studies satisfactory to the AO of the impacts on soils and vegetation of the specific low-ground-pressure vehicles to be used; these studies should reflect use of such vehicles under conditions similar to those of the route proposed for use, and they should demonstrate that the proposed use would have no more than minimal impacts on soils and vegetation. b. Submitted surveys satisfactory to the AO of subsistence uses of the area as well as of the soils, vegetation, hydrology, wildlife and fish (and their habitats), paleontological and archaeological resources, and other resources, as required by the AO. c. Designed and/or modified the use proposal to minimize impacts to the AO's satisfaction. design steps to achieve the objectives and based upon the studies and surveys may include, but not be limited to, timing restrictions (generally it is considered inadvisable to conduct tundra travel prior to August 1 to protect ground-nesting birds), shifting of work to winter, rerouting, and not proceeding when certain wildlife are present or subsistence activities are occurring. At the discretion of the AO, the plan for	***ROP L-1: Tundra Travel*** Objective: Protect stream banks and water quality; minimize compaction and displacement of soils; minimize the breakage, abrasion, compaction, or displacement of vegetation; protect cultural and paleontological resources; maintain populations of and adequate habitat for birds, fish, and caribou and other terrestrial mammals; and minimize impacts on subsistence activities. Requirement/Standard: On a case-by-case basis, the BLM may permit low-ground-pressure vehicles to travel off of gravel pads and roads during times other than those identified in ROP C-2a. Permission for such use would be granted only after an applicant has completed the following: a. Submitted surveys satisfactory to the AO of subsistence uses of the area, as well as of the soils, vegetation, hydrology, wildlife and fish and their habitats, paleontological and archaeological resources, and other resources, as required by the AO. b. Designed and/or modified the use proposal to minimize impacts to the AO's satisfaction. Design steps to achieve the objectives and based upon the studies and surveys may include, but not be limited to, timing restrictions (generally it is considered inadvisable to conduct tundra travel prior to August 1 to protect ground-nesting birds), shifting work to winter, rerouting, and not proceeding when certain wildlife are present or subsistence activities are occurring. c. Submitted off-road travel as part of a vehicle use plan for AO approval.

Alternative A	Alternatives B, C, and D
summer tundra vehicle access may be included as part of the Spill Prevention, Control, and Countermeasure plan required by 40 CFR 112 (Oil Pollution Act) and BMP A-4.	See **ROP E-13** for additional requirements to protect cultural and paleontological resources.
M. General Wildlife and Habitat Protection	
BMP M-1 Objective: Minimize disturbance and hindrance of wildlife or alteration of wildlife movements through the NPR-A. Requirement/Standard: Chasing wildlife with ground vehicles is prohibited. Particular attention would be given to avoid disturbing caribou.	***ROP M-1: Vehicle Use Plans*** Objective: Minimize disturbance and hindrance of wildlife, or alteration of wildlife movement. Requirement/Standard: Permittees will submit a vehicle use plan with their permit application for approval by the AO, in consultation with the appropriate federal, State, and NSB regulatory and resource agencies. Vehicle use plans will have the following elements: a) Following wildlife with ground vehicles is prohibited. Particular attention would be given to avoid disturbing caribou. b) The management plan would follow industry practices to minimize or mitigate delays to caribou movement, vehicle collisions, or displacement during calving, spring migration, fall migration, and post-insect aggregation movement. By direction of the AO, traffic may be stopped throughout a defined area for up to 4 weeks to prevent displacement of calving caribou. c) Summary of all planned off road travel, including the number of vehicles, type and general routes. d) Strategies for complying with **K-6, K-8, K-9 and K-14**, if applicable. e) Monitoring may be required as part of the vehicle use plan. If required, a monitoring plan could include collection of data on vehicle counts and vehicle interactions with wildlife. The AO may require adjustments to the vehicle use plan, based on the results of the monitoring. f) Permittees shall provide an annual report to the AO and BLM Alaska Wildlife program lead, reporting roadkill of birds and mammals to help the BLM to determine whether preventative measures on vehicle collisions are effective.
BMP M-2 Objective: Prevent the introduction, or spread, of nonnative, invasive plant species in the NPR-A. Requirement/Standard: Certify that all equipment and vehicles (intended for use either off or on roads) are weed-free prior to transporting them into the NPR-A. Monitor annually along roads for nonnative invasive species and initiate effective weed control measures upon evidence of their introduction. Prior to operations in the NPR-A, submit a plan for the BLM's approval, detailing the methods for cleaning equipment and vehicles, monitoring for weeds and weed control.	***ROP M-2: Invasive Species Prevention Plan*** Objective: Prevent the introduction, or spread of non-native, invasive plant species in the NPR-A. Requirement/Standard: Prior to operations in the NPR-A, permittee shall submit a plan for the BLM's approval detailing the methods for cleaning equipment and vehicles, monitoring for weeds, and weed control. Permittee shall monitor annually along roads for nonnative invasive species and initiate effective weed control measures upon evidence of their introduction. See **ROP M-5** for requirements to reduce areas of bare soil.
BMP M-3 Objective: Minimize loss of populations of and habitat for, plant species designated as sensitive by the BLM in Alaska. Requirement/Standard: If a development is proposed in an area that provides potential habitat for a BLM sensitive plant species, the development proponent would conduct surveys at appropriate times of the summer season and in appropriate habitats for the sensitive plant species that might occur there. The results of these surveys would be submitted to the BLM with the application for development.	***ROP M-3: Surveys for Sensitive Plant Species*** Objective: Minimize loss of populations of and habitat for plant species designated as sensitive by the BLM in Alaska. Requirement/Standard: If a development is proposed in an area that provides potential habitat for a BLM sensitive plant species, the development proponent would conduct surveys at appropriate times of the summer season and in appropriate habitats for the sensitive plant species that might occur there. The results of these surveys would be submitted to the BLM with the application for development, and the AO would implement appropriate avoidance and minimization measures.
BMP M-4: Sensitive Mammalian Species Objective: Minimize loss of individuals of and habitat for mammalian species designated as sensitive by the BLM in Alaska. Requirement/Standard: If a development is proposed in an area that provides potential habitat for the Alaska tiny shrew, the development proponent would conduct surveys at appropriate times of the year and in appropriate habitats in an effort to detect the presence of the shrew. The results of these surveys would be submitted to the BLM with the application for development.	***ROP M-4: Sensitive Wildlife Species*** Objective: Minimize loss of individuals and habitat for wildlife species designated as sensitive by the BLM in Alaska. Requirement/Standard: If a development is proposed in an area that provides potential habitat for a wildlife species designated as sensitive by the BLM in Alaska, the development proponent would conduct surveys at appropriate times of the year and in appropriate habitats in an effort to detect the presence of the species. The results of these surveys would be submitted to the BLM with the application for development, and the AO would implement appropriate avoidance and minimization measures.
No similar requirement.	***ROP M-5: Minimize Bare Soil*** Objective: Reduce areas of bare soil that can contribute to dust emission to protect human health and subsistence resources. Requirement/Standard: Permittees will use appropriate measures to control dust (e.g. dust palliatives, watering), as outlined in dust control plans submitted to ADEC pursuant to 18 AAC 50.045(d). Areas of bare soil resulting from operations will be revegetated with native species within 48 months of abandonment, unless otherwise specified in the abandonment and reclamation plan.
Lease Notices	
No similar requirement	***Lease Notice 1: Liability for Wildfires*** a. Permittees who start a fire are liable for the costs of wildfire suppression and damages to property and natural resources. b. Infrastructure built by permittees on BLM-managed land shall be protected from wildfire, in accordance with the Alaska Remote Structure Protection Policy. The BLM will not be held liable for damages to private property caused by wildfire, regardless of the cause of the fire.
BMP J. The lease areas may now or hereafter contain plants or animals or their habitats determined to be threatened or endangered or to have some other special status. The BLM may recommend modifications to exploration and development proposals to further its conservation and management objective to avoid activities it has approved that would contribute to the need to list such a species or its habitat. The BLM may require modifications to or may disapprove a proposed activity that is likely to adversely affect a proposed or listed endangered species, threatened species, or critical habitat. The BLM would not approve any activity that could affect any such species or critical habitat until it completes its obligations under applicable requirements of the E Endangered Species Act, 16 USC 1531 et seq., including completing any required procedure for conference or consultation.	***Lease Notice 2: Compliance with the Endangered Species Act*** The lease areas may now or hereafter contain plants, animals, or their habitats determined to be threatened or endangered. The BLM may require modifications to exploration and development proposals to further its conservation and management objective to avoid activities it has approved that would contribute to the need to list such a species or designate critical habitat for listed species. The BLM will not approve any activity that may affect any such species or critical habitat until it completes its obligations under applicable requirements of the Endangered Species Act, 16 USC 1531 et seq., including completing any required procedure for conference or consultation.

Table 2-3
Additional Protections that Apply in Select Biologically Sensitive Areas

Alternative A	Alternative B	Alternative C	Alternative D
K-1: River Setbacks • No surface occupancy • No new infrastructure, except essential road and pipeline crossings • Sand and gravel mining (mineral materials disposal) authorized on a case-by-case basis This measure would be applied to relevant new leases. On lands unavailable for leasing, K-1 would be a BMP. The decision indicated below under a and *d* modify Protection 1 of the Colville River Special Area Management Plan by widening its applicability to 2 miles. Objective**:** Minimize the disruption of natural flow patterns and changes to water quality; the disruption of natural functions resulting from the loss or change to vegetative and physical characteristics of floodplain and riparian areas; the loss of spawning, rearing, or overwintering habitat for fish; the loss of cultural and paleontological resources; the loss of raptor habitat; impacts on subsistence cabins and campsites; the disruption of subsistence activities; and impacts on scenic and other resource values. Requirement/Standard**:** Permanent oil and gas facilities, including gravel pads, roads, airstrips, and pipelines, are prohibited in the streambed and next to the rivers listed below at the distances identified. (Gravel mines may be in the active floodplain, consistent with BMP E-8). On a case-by case basis and in consultation with federal, State, and NSB regulatory and resource agencies, based on agency legal authority and jurisdictional responsibility, the BLM would permit essential pipeline and road crossings to the main channel through setback areas. The below setbacks may not be practical in river deltas; if not, permanent facilities shall be designed to withstand a 200-year flood. In the list, if no upper limit for the setback is indicated, it would extend to the head of the stream as identified in the National Hydrography Dataset. a. **Colville River:** A 2-mile setback from the boundary of the NPR-A, where the river determines the boundary along the Colville River, as determined by cadastral survey, to be the highest high watermark on the left (western or northern) bank and from both banks' ordinary high watermark where the BLM-manages both sides of the river up through T5S, R30W, U.M. Above that point to its source at the juncture of Thunder and Storm creeks the setback would be 0.5 mile. Note**:** The planning area excludes conveyed Native lands along the lower reaches of the Colville River. Development of road crossings intended to support oil and gas activities shall be consolidated with other similar projects and uses to the maximum extent possible. This provision does not apply to intercommunity or other permanent roads constructed with public funds for general transportation purposes, though the BLM would encourage minimal use of the setback area. This preserves the opportunity to plan, design, and construct public transportation systems to meet the economic, transportation, and public health and safety needs of the State of Alaska and communities in NPR-A. b. **Ikpikpuk River:** A 2-mile setback from of the ordinary high watermark of the Ikpikpuk River extending from the mouth upstream through T7 N, R11W, U.M.; above that the setback	***K-1: River Setbacks*** • No surface occupancy • No new infrastructure, except essential road and pipeline crossings • Sand and gravel mining authorized on a case-by-case basis except, for a designated portion of Fish Creek, which is closed Objective**:** Same as Alternative A. Requirement/Standard**:** Permanent oil and gas facilities, such as gravel pads, roads, airstrips, and pipelines, and new infrastructure are prohibited in the streambed and next to the rivers listed below at the distances identified. On a case-by-case basis, and in consultation with federal, State, and NSB regulatory and resource agencies, as appropriate, based on agency legal authority and jurisdictional responsibility, essential pipeline and road crossings to the main channel would be permitted through setback areas. In addition, sand and gravel mining may be permitted on a case-by-case basis, in consultation with the NSB, except in the area specified below around Fish Creek, where sand and gravel mining is prohibited. Sand and gravel mining along the important subsistence rivers, listed in ROP F-4, would be permitted on a case-by-case basis and would be restricted to the winter only. Gravel mines may be in the active floodplain, consistent with ROP E-8. The below setbacks may not be practical in river deltas; in such deltas, permanent facilities shall be designed to withstand a 200-year flood event in consultation with the BLM AO. In the list, if no upper limit for the setback is indicated, the setback extends to the head of the stream as identified in the National Hydrography Dataset. a. **Fish Creek:** A 3-mile setback from the highest high watermark of the creek downstream of the eastern edge of section 31, T11N, R1E., U.M. and a 0.5-mile setback from the bank's highest high watermark farther upstream. Sand and gravel mining is prohibited in the 3-mile portion of the Fish Creek setback. b. **Colville River:** A 7-mile setback from the boundary of the NPR-A, where the river determines the boundary along the Colville River, as determined by cadastral survey to be the highest high watermark on the left (western or northern) bank and from both banks' ordinary high watermark where the BLM manages both sides of the river to the juncture of Thunder and Storm creeks. (Note**:** The planning area excludes conveyed Native lands along the lower reaches of the Colville River. Development of road crossings intended to support oil and gas activities shall be consolidated with other similar projects and uses to the maximum extent possible. This provision does not apply to intercommunity or other permanent roads constructed with public funds for general transportation purposes, though the BLM would encourage minimal use of the setback area. This preserves the opportunity to plan, design, and construct public transportation systems to meet the economic, transportation, and public health and safety	***K-1: River Setbacks*** Same as Alternative B Objective**:** Same as Alternative A. Requirement/Standard**:** Permanent oil and gas facilities (e.g., gravel pads, roads, airstrips, and pipelines) are prohibited in the streambed and adjacent to the rivers listed below at the distances identified. On a case-by-case basis, and in consultation with federal, State, and NSB regulatory and resource agencies (as appropriate, based on agency legal authority and jurisdictional responsibility), essential pipeline and road crossings to the main channel would be permitted through setback areas. In addition, sand and gravel mining may be permitted on a case-by-case basis, in consultation with the NSB, except in the area specified below around Fish Creek, where sand and gravel mining is prohibited. Sand and gravel mining activity along the important subsistence rivers, listed in ROP F-4, would be permitted on a case-by-case basis and restricted to winter activity only. Gravel mines may be located within the active floodplain, consistent with ROP E-8. The below setbacks may not be practical within river deltas; in such deltas, permanent facilities shall be designed to withstand a 200-year flood event in consultation with the BLM AO. In the below list, if no upper limit for the setback is indicated, the setback extends to the head of the stream, as identified in the National Hydrography Dataset. a. **Fish Creek:** A 3-mile setback from the highest high watermark of the creek downstream from the eastern edge of section 31, T11N, R1E., U.M. and a 0.5-mile setback from the bank's highest high watermark farther upstream. Sand and gravel mining is prohibited in the 3-mile portion of the Fish Creek setback. b. **Colville River:** A 3-mile setback from the boundary of NPR-A, where the river determines the boundary along the Colville River, as determined by cadastral survey to be the highest high watermark on the left (western or northern) bank and from both banks' ordinary high watermark, where the BLM manages both sides of the river up through T1S, R1W, U.M. Above that point to its source at the juncture of Thunder and Storm creeks the setback would be 1 mile. Note**:** The planning area excludes conveyed Native lands along the lower reaches of the Colville River. Development of road crossings intended to support oil and gas activities shall be consolidated with other similar projects and uses to the maximum extent practicable. This provision does not apply to intercommunity or other permanent roads constructed with public funds for general transportation purposes, though the BLM would encourage minimal use of the setback area. This preserves the opportunity to plan, design, and construct public transportation systems to meet the economic, transportation, and public health and safety needs of the State of Alaska and/or communities within NPR-A.	***K-1: River Setbacks*** Same as Alternative C.

Alternative A	Alternative B	Alternative C	Alternative D
would be for 1 mile to the confluence of the Kigalik River and Maybe Creek. c. **Miguakiak River:** A 0.5-mile setback from the ordinary high watermark. d. **Kikiakrorak and Kogosukruk Rivers:** A 2-mile setback from the top of the bluff (or ordinary high watermark, if there is no bluff) on the Kikiakrorak River downstream from T2N., R4W, U.M. and on the Kogosukruk River (including the branch of Kogosukruk River, Henry Creek, and two unnamed tributaries off the southern bank) downstream from T2N, R3W, U.M. The setback from these streams in the named townships and farther upstream as applicable would be 0.5 miles from the top of the bluff or from the bank if there is no bluff. e. **Fish Creek:** A 3-mile setback from the highest high watermark of the creek downstream from the eastern edge of section 31, T11N, R1E., U.M. and a 0.5-mile setback from the bank's highest high watermark farther upstream. f. **Judy Creek:** A 0.5-mile setback from the ordinary high water mark. g. **Ublutuoch (Tiŋmiaqsiugvik) River:** A 0.5-mile setback from the ordinary high water mark. h. **Alaktak River:** A 1-mile setback from the ordinary high water mark. i. **Chipp River:** A 1-mile setback from the ordinary high water mark. j. **Oumalik River:** a 0.5-mile setback from the Oumalik River ordinary high water mark from the mouth upstream to section 5, T8N, R14W, U.M., and a 0.5-mile setback in and above section 5, T8N, R14W, U.M. k. **Titaluk River:** A 2-mile setback from the ordinary high water mark from its confluence with the Ikpikpuk River upstream through T7N, R12W, U.M.; above that point the setback would be 0.5 miles from the ordinary high water mark. l. **Kigalik River:** A 0.5-mile setback from the ordinary high water mark. m. **Maybe Creek:** A 0.5-mile setback from the ordinary high water mark. n. **Topagoruk River:** A 1-mile setback from the ordinary high water mark. o. **Ishuktak Creek:** A 0.5-mile setback from the ordinary high water mark. p. **Meade River:** A 1-mile setback from the ordinary high water mark on BLM-managed lands. q. **Usuktuk River:** A 1-mile setback from the ordinary high water mark on BLM-managed lands. r. **Pikroka Creek:** A 0.5-mile setback from the ordinary high water mark. s. **Nigisaktuvik River:** A 1-mile setback from the ordinary high water mark. t. **Inaru River:** A 1-mile setback from the ordinary high water mark. u. **Kucheak Creek:** A 0.5-mile setback from the ordinary high water mark. v. **Avalik River:** A 1-mile setback from the ordinary high water mark. w. **Niklavik Creek:** A 0.5-mile setback from the ordinary high water mark. x. **Kugrua River:** A 0.5-mile setback from the ordinary high water mark. y. **Kungok River:** A 1-mile setback from the ordinary high water mark on BLM-managed lands.	needs of the State of Alaska and communities in the NPR-A.) c. **Ikpikpuk River:** A 2-mile setback from of the ordinary high watermark of the Ikpikpuk River, extending from the mouth upstream through T7 N, R11W, U.M.; above that the setback would be for 1 mile to the confluence of the Kigalik River and Maybe Creek. d. **Kikiakrorak and Kogosukruk Rivers:** A 2-mile setback, from the top of the bluff (or ordinary high watermark, if there is no bluff) on the Kikiakrorak River downstream of T2N., R4W, U.M. and on the Kogosukruk River (including unnamed branches of Kogosukruk River, Henry Creek, and two unnamed tributaries off the southern bank) downstream from T2N, R3W, U.M (see **Appendix A**, **Map 2-3 and Map 2-4**). The setback from these streams in the named townships and farther upstream as applicable would be 0.5 miles from the top of the bluff or from the bank if there is no bluff. e. **Titaluk River:** A 2-mile setback from the ordinary high water mark, from its confluence with the Ikpikpuk River upstream through T7N, R12W, U.M.; above that point the setback would be 0.5 miles from the ordinary high water mark. f. **1-mile setback from the ordinary high water mark of the following rivers:** 1) Alaktak River 2) Chipp River 3) Topagoruk River 4) Meade River 5) Usuktuk River 6) Nigisaktuvik River 7) Inaru River 8) Avalik River 9) Kungok River 10) Kuk River 11) Ketik River 12) Kaolak River 13) Ivisaruk River 14) Utukok River 15) Kokolik River 16) Kugrua River g. **0.5-mile setback from the ordinary high watermark of the following rivers:** 1) Miguakiak River 2) Judy Creek 3) Ublutuoch (Tiŋmiaqsiugvik) River 4) Oumalik River: from the Oumalik River ordinary high water mark from the mouth upstream to section 5, T8N, R14W, U.M., and a 0.5-mile setback in and above section 5, T8N, R14W, U.M. 5) Kigalik River 6) Maybe Creek. 7) Ishuktak Creek 8) Pikroka Creek 9) Kucheak Creek 10) Niklavik Creek 11) Kolipsun Creek from upstream through T13N, R28W, U.M. 12) Maguriak Creek: from upstream through T12N, R29W, U.M.	c. **Ikpikpuk River:** A 2-mile setback from the ordinary high watermark of the Ikpikpuk River extending from the mouth upstream through T7 N, R11W, U.M.; above that the setback would be for 1 mile to the confluence of the Kigalik River and Maybe Creek. d. **Kikiakrorak and Kogosukruk Rivers:** A 2-mile setback from the top of the bluff or ordinary high watermark if there is no bluff on the Kikiakrorak River downstream from T2N., R4W, U.M. and on the Kogosukruk River (including the branch of Kogosukruk River, Henry Creek, and two unnamed tributaries off the southern bank) downstream from T2N, R3W, U.M. The setback from these streams in the named townships and farther upstream as applicable would be 0.5 miles from the top of the bluff or bank if there is no bluff. e. **Titaluk River:** A 2-mile setback from the ordinary high water mark from its confluence with the Ikpikpuk River upstream through T7N, R12W, U.M.; above that point the setback would be 0.5 miles from the ordinary high water mark. f. **1-mile setback from the ordinary high water mark of the following rivers:** 1) Alaktak River 2) Chipp River 3) Topagoruk River 4) Meade River 5) Usuktuk River 6) Nigisaktuvik River 7) Inaru River 8) Avalik River 9) Kungok River 10) Kuk River 11) Ketik River 12) Kaolak River 13) Ivisaruk River 14) Utukok River 15) Kokolik River g. **0.5-mile setback from the ordinary high watermark of the following rivers:** 1) Miguakiak River 2) Judy Creek 3) Ublutuoch (Tiŋmiaqsiugvik) River 4) Oumalik River: from the Oumalik River ordinary high water mark from the mouth upstream to section 5, T8N, R14W, U.M., and a 0.5-mile setback in and above section 5, T8N, R14W, U.M. 5) Kigalik River 6) Maybe Creek. 7) Ishuktak Creek 8) Pikroka Creek 9) Kucheak Creek 10) Niklavik Creek 11) Kugrua River 12) Kolipsun Creek from upstream through T13N, R28W, U.M. 13) Maguriak Creek: from upstream through T12N, R29W, U.M. 14) Mikigealiak River: from upstream through T12N, R30W, U.M. 15) Nokotlek River	*(see above)*

Alternative A	Alternative B	Alternative C	Alternative D
z. **Kolipsun Creek:** A 0.5-mile setback from the ordinary high water mark upstream through T13N, R28W, U.M. aa. **Maguriak Creek:** A 0.5-mile setback from the ordinary high water mark upstream through T12N, R29W, U.M. ab. **Mikigealiak River:** A 0.5-mile setback from the ordinary high water mark upstream through T12N, R30W, U.M. ac. **Kuk River:** A 1-mile setback from the ordinary high water mark on BLM-managed lands. ad. **Ketik River:** A 1-mile setback from the ordinary high water mark. ae. **Kaolak River:** A 1-mile setback from the ordinary high water mark. af. **Ivisaruk River:** A 1-mile setback from the ordinary high water mark. ag. **Nokotlek River:** A 0.5-mile setback from the ordinary high water mark. ah. **Ongorakvik River:** A 0.5-mile setback from the ordinary high water mark. ai. **Tunalik River:** A 0.5-mile setback from the ordinary high water mark. aj. **Avak River:** A 0.5-mile setback from the ordinary high water mark within the NPR-A. ak. **Nigu River:** A 0.5-mile setback from the ordinary high water mark from the confluence with the Etivluk River upstream to the boundary of NPR-A. al. **Etivluk River:** A 0.5-mile setback from the ordinary high water mark. am. **Ipnavik River:** A 0.5-mile setback from the ordinary high water mark. an. **Kuna River:** A 0.5-mile setback from the ordinary high water mark. ao. **Kiligwa River:** A 0.5-mile setback from the ordinary high water mark. ap. **Nuka River:** A 0.5-mile setback from the ordinary high water mark. aq. **Driftwood Creek:** A 0.5-mile setback from the ordinary high water mark. ar. **Utukok River:** A 1-mile setback from the ordinary high water mark within the NPR-A. as. **Awuna River:** A 0.5-mile setback from the ordinary high water mark. at. **Carbon Creek:** A 0.5-mile setback from the ordinary high water mark. au. **Kokolik River:** A 1-mile setback from the ordinary high water mark within the NPR-A. av. **Keolok Creek:** A 0.5-mile setback from the ordinary high water mark. The decisions in subparagraphs K-1(a) and K-1(d) modify Colville River Management Plan Protection 1 by widening the setback in that measure to 2 miles. Protection 1 thus is modified to the following: **Colville River Special Area Management Plan Protection** Objective: Minimize the loss of arctic peregrine falcon nesting habitat in the Colville River Special Area. Requirement/Standard: To minimize the direct loss of arctic peregrine falcon nesting habitat and to protect nest sites in the Colville River Special Area the following protective measures apply: Permanent oil and gas facilities, including gravel pads, roads, airstrips, and pipelines, are prohibited in the stream bed and	13) Mikigealiak River: from upstream through T12N, R30W, U.M. 14) Nokotlek River 15) Ongorakvik River 16) Tunalik River 17) Avak River 18) Nigu River: from the confluence with the Etivluk River upstream to the boundary of NPR-A 19) Etivluk River 20) Ipnavik River 21) Kuna River 22) Kiligwa River 23) Driftwood Creek 24) Nuka River 25) Awuna River 26) Carbon Creek 27) Keolok Creek	16) Ongorakvik River 17) Tunalik River 18) Avak River 19) Nigu River: from the confluence with the Etivluk River upstream to the boundary of NPR-A 20) Etivluk River 21) Ipnavik River 22) Kuna River 23) Kiligwa River 24) Driftwood Creek 25) Nuka River 26) Awuna River 27) Carbon Creek 28) Keolok Creek	*(see above)*

Alternative A	Alternative B	Alternative C	Alternative D
adjacent to the rivers listed below at the distances identified. On a case-by-case basis, and in consultation with federal, State, and NSB regulatory and resource agencies as appropriate, based on agency legal authority and jurisdictional responsibility, essential pipeline and road crossings perpendicular to the main channel would be permitted through setback areas. a. Colville River: Downstream of the Etivluk River a continuous 2-mile setback measured from the highest high watermark on the left bank (facing downstream); upstream of the Etivluk River a 2-mile setback measured from the ordinary high watermark of the bank on both sides of the river. Development of road crossings intended to support oil and gas activities shall be consolidated with other similar projects and uses to the maximum extent possible. This provision does not apply to intercommunity or other permanent roads constructed with public funds for general transportation purposes. b. Kikiakrorak River: Downstream of T2N, R4W, U.M., a continuous 2-mile setback, as measured from the top of the bluff, or bank if there is no bluff, of both sides of the river. c. Kogosukruk River: Downstream of T2N, R3W, U.M., a continuous 2-mile setback, as measured from the top of the bluff, or bank if there is no bluff, of both sides of the river and several of its tributaries.	*(see above)*	*(see above)*	*(see above)*
K-2 Deep Water Lakes • No surface occupancy • BMP for new infrastructure • Sand and gravel mining authorized on a case-by-case basis Note: This measure would be applied to relevant new leases. On lands unavailable for leasing, K-2 would be a BMP. Objective: Minimize the disruption of natural flow patterns and changes to water quality; the disruption of natural functions resulting from the loss or change to vegetative and physical characteristics of deep water lakes; the loss of spawning, rearing or overwintering habitat for fish; the loss of cultural and paleontological resources; impacts on subsistence cabin and campsites; and the disruption of subsistence activities. Requirement/Standard: Generally, permanent oil and gas facilities, including gravel pads, roads, airstrips, and pipelines, are prohibited on the lake or lakebed and within a quarter-mile of the ordinary high water mark of any deep lake determined to be in lake zone III (i.e., depth greater than 13 feet [4 meters]; Mellor 1985). On a case-by-case basis in consultation with federal, State, and NSB regulatory and resource agencies (as appropriate based on agency legal authority and jurisdictional responsibility), essential pipeline(s), road crossings, and other permanent facilities may be considered through the permitting process in these areas where the lessee can demonstrate on a site-specific basis that impacts would be minimal.	***K-2 Deep Water Lakes*** • No surface occupancy • No new infrastructure • Sand and gravel mining authorized on a case-by-case basis Objective: Minimize the disruption of natural flow patterns and changes to water quality; the disruption of natural functions resulting from the loss or change to vegetative and physical characteristics of deep water lakes; the loss of spawning, rearing or overwintering habitat for fish; the loss of cultural and paleontological resources; impacts on subsistence cabin and campsites; and the disruption of subsistence activities. Requirement/Standard: Generally, permanent oil and gas facilities (e.g., gravel pads, roads, airstrips, and pipelines) and new infrastructure are prohibited on the lake or lakebed and within 0.25 miles of the ordinary high watermark of any deep lake, as determined to be in lake zone III (i.e., depth greater than 13 feet [4 meters]; Mellor 1985). On a case-by-case basis in consultation with federal, State, and NSB regulatory and resource agencies (as appropriate, based on agency legal authority and jurisdictional responsibility), essential pipeline(s), road crossings, and other permanent facilities may be considered through the permitting process in these areas, where the lessee can demonstrate on a site-specific basis that impacts would be minimal. Additional restrictions as described in **ROP E-11** may also apply in those habitats.	***K-2 Deep Water Lakes*** • No surface occupancy • ROP for new infrastructure • Sand and gravel mining authorized on a case-by-case basis Objective: Same as Alternative B. Requirement/Standard: Same as Alternative A. Additional restrictions as described in E-11 may also apply in those habitats.	Same as Alternative C.
K-3: Waterbodies and Riparian Areas Objective: Protect fish-bearing rivers, streams, and lakes from blowouts and minimize alteration of riparian habitat. Requirement/Standard: Exploratory drilling is prohibited in rivers and streams, as determined by the active floodplain, and fish-bearing lakes.	***K-3: Waterbodies and Riparian Areas*** Objective: Protect rivers, streams, lakes, and riparian habitat from oil and gas exploratory drilling impacts. Requirement/Standard: Prohibit exploratory drilling in rivers, streams, lakes, and riparian habitat, as determined by the active floodplain.	Same as Alternative B.	Same as Alternative A.

Alternative A	Alternative B	Alternative C	Alternative D
K-4 Kogru River, Dease Inlet, Admiralty Bay, Elson Lagoon, Peard Bay, Wainwright Inlet/Kuk River, and Kasegaluk Lagoon, and their associated Islands • No leasing • No new infrastructure, except essential pipeline crossings (see ROP for pipeline crossings) • Sand and gravel mining authorized on a case-by-case basis Objective: Protect fish and wildlife habitat (including, but not limited to, that for waterfowl and shorebirds, caribou insect-relief, and marine mammals), preserve air and water quality, and minimize impacts on subsistence activities and historic travel routes on the major coastal waterbodies. Requirement/Standard: The Kogru River, Dease Inlet, Admiralty Bay, Elson Lagoon, Peard Bay, Wainwright Inlet/Kuk River, and Kasegaluk Lagoon and their associated Islands are unavailable for leasing. With the exception of linear features such as pipelines, no permanent oil and gas facilities are permitted on or under the water within three-quarters of a mile seaward of the shoreline (as measured from mean high tide) of the major coastal waterbodies or the natural coastal islands (to the extent that the seaward subsurface is within NPR-A). Elsewhere, permanent facilities within the major coastal waterbodies would only be permitted on or under the water if they can meet all the following criteria: a. Design and construction of facilities shall minimize impacts on subsistence uses, travel corridors, seasonally concentrated fish and wildlife resources. b. Daily operational activities, including use of support vehicles, watercraft, and aircraft traffic, alone or in combination with other past, present, and reasonably foreseeable activities, shall be conducted to minimize impacts on subsistence uses, travel corridors, and seasonally concentrated fish and wildlife resources. c. The location of oil and gas facilities, including artificial islands, platforms, associated pipelines, ice or other roads, bridges or causeways, shall be sited and constructed so as to not pose a hazard to navigation by the public using traditional high-use subsistence-related travel routes into and through the major coastal waterbodies as identified by the NSB. d. Demonstrated year-round oil spill response capability, including the capability of adequate response during periods of broken ice or open water, or the availability of alternative methods to prevent well blowouts during periods when adequate response capability cannot be demonstrated. Such alternative methods may include seasonal drilling restrictions, improvements in blowout prevention technology, equipment and/or changes in operational procedures, and "top-setting" of hydrocarbon-bearing zones. e. Reasonable efforts shall be made to avoid or minimize impacts related to oil spill response activities, including vessel, aircraft, and pedestrian traffic that add to impacts or further compound direct spill-related impacts on area resources and subsistence uses. f. Before conducting open water activities, the permittee shall consult with the Alaska Eskimo Whaling Commission and the NSB to minimize impacts on the fall and spring subsistence whaling activities of the communities of the North Slope.	***K-4 Kogru River, Dease Inlet, Admiralty Bay, Elson Lagoon, Peard Bay, Wainwright Inlet/Kuk River, and Kasegaluk Lagoon, and their associated Islands*** • No leasing • No new infrastructure, except essential pipeline crossings (see ROP for pipeline crossings) • Sand and gravel mining authorized on a case-by-case basis Objective: Same as Alternative A. Requirement/Standard: With the exception of linear features, such as pipelines, no permanent oil and gas facilities are permitted on or under the water within three-quarters of a mile seaward of the shoreline (as measured from mean high tide) of the major coastal waterbodies or the natural coastal islands (to the extent that the seaward subsurface is within NPR-A). This same area is closed to new infrastructure, with the exception of essential pipeline crossings. Sand and gravel mining would be authorized on a case-by-case-basis. Essential pipeline crossings would be permitted only on or under the water if they can meet all the following criteria: a. Design and construction of facilities shall minimize impacts on subsistence uses, travel corridors, seasonally concentrated fish and wildlife resources. b. Daily operational activities, including use of support vehicles, watercraft, and aircraft traffic, alone or in combination with other past, present, and reasonably foreseeable activities, shall be conducted to minimize impacts on subsistence uses, travel corridors, and seasonally concentrated fish and wildlife resources. c. The location of oil and gas facilities, including artificial islands, platforms, associated pipelines, ice or other roads, bridges or causeways, shall be sited and constructed so as to not pose a hazard to navigation by the public using traditional high-use subsistence-related travel routes into and through the major coastal waterbodies, as identified by the NSB. d. Demonstrated year-round oil spill response capability, including the capability of adequate response during periods of broken ice or open water, or the availability of alternative methods to prevent well blowouts during periods when adequate response capability cannot be demonstrated. Such alternative methods may include seasonal drilling restrictions, improvements in blowout prevention technology, equipment and/or changes in operational procedures, and "top-setting" wells above the hydrocarbon-bearing zone. e. Reasonable efforts shall be made to avoid or minimize impacts related to oil spill response activities, including vessel, aircraft, and pedestrian traffic that add to impacts or further compound direct spill-related impacts on area resources and subsistence uses. f. Before conducting open water activities, the permittee shall consult with the Alaska Eskimo Whaling Commission and the NSB to minimize impacts on the fall and spring subsistence whaling activities of the communities of the North Slope.	***K-4 Kogru River, Dease Inlet, Admiralty Bay, Elson Lagoon, Peard Bay, Wainwright Inlet/Kuk River, and Kasegaluk Lagoon, and their associated Islands*** • No Leasing (Dease Inlet, Admiralty Bay, Elson Lagoon, Peard Bay, Wainwright Inlet/Kuk River, and Kasegaluk Lagoon, and their associated Islands) • No surface occupancy (Kogru River) • No new infrastructure except essential pipeline crossings (see ROP for pipeline crossings) • Sand and gravel mining authorized on a case-by-case basis Objective: Same as Alternative A. Requirement/Standard: Dease Inlet, Admiralty Bay, Elson Lagoon, Peard Bay, Wainwright Inlet/Kuk River, and Kasegaluk Lagoon and their associated Islands are unavailable for leasing. These same areas are closed to new infrastructure, with the exception of essential pipeline crossings. The Kogru River is available for leasing, subject to a no surface occupancy stipulation. New infrastructure would not be permitted in the Kogru River, except for essential pipeline crossings. Essential pipeline crossings would only be permitted on or under the water if they can meet all the following criteria: a. Design and construction of facilities shall minimize impacts on subsistence uses, travel corridors, and seasonally concentrated fish and wildlife resources. b. Daily operational activities, including use of support vehicles, watercraft, and aircraft traffic, alone or in combination with other past, present, and reasonably foreseeable activities, shall be conducted to minimize impacts on subsistence uses, travel corridors, and seasonally concentrated fish and wildlife resources. c. The location of oil and gas facilities, including artificial islands, platforms, associated pipelines, ice or other roads, bridges or causeways, shall be sited and constructed so as to not pose a hazard to navigation by the public using traditional high-use subsistence-related travel routes into and through the major coastal waterbodies, as identified by the NSB. d. Demonstrated year-round oil spill response capability, including the capability of adequate response during periods of broken ice or open water, or the availability of alternative methods to prevent well blowouts during periods when adequate response capability cannot be demonstrated. Such alternative methods may include seasonal drilling restrictions, improvements in blowout prevention technology, equipment and/or changes in operational procedures, and "top-setting" wells above the hydrocarbon-bearing zone. e. Reasonable efforts shall be made to avoid or minimize impacts related to oil spill response activities, including vessel, aircraft, and pedestrian traffic that add to impacts or further compound direct spill-related impacts on area resources and subsistence uses. f. Before conducting open water activities, the permittee shall consult with the Alaska Eskimo Whaling Commission	***K-4 Kogru River, Dease Inlet, Admiralty Bay, Elson Lagoon, Peard Bay, Wainwright Inlet/Kuk River, and Kasegaluk Lagoon, and their associated Islands*** • No Leasing (Peard Bay, Wainwright Inlet/Kuk River, and Kasegaluk Lagoon, and their associated Islands) • No surface occupancy (Kogru River, Dease Inlet, Admiralty Bay, and Elson Lagoon, and their associated islands) • No new infrastructure except essential pipeline crossings (see ROP for pipeline crossings) • Sand and gravel mining authorized on a case-by-case basis Objective: Same as Alternative A. Requirement/Standard: Peard Bay, Wainwright Inlet/Kuk River, and Kasegaluk Lagoon, and their associated Islands are unavailable for leasing. These same areas are closed to new infrastructure, with the exception of essential pipeline crossings. The Kogru River, Dease Inlet, Admiralty Bay, Elson Lagoon, and their associated islands are available for leasing, subject to a no surface occupancy stipulation. New infrastructure would not be permitted, except for essential pipeline crossings. Essential pipeline crossings would be permitted only on or under the water if they can meet all the following criteria: a. Design and construction of facilities shall minimize impacts on subsistence uses, travel corridors, seasonally concentrated fish and wildlife resources. b. Daily operational activities, including use of support vehicles, watercraft, and aircraft traffic, alone or in combination with other past, present, and reasonably foreseeable activities, shall be conducted to minimize impacts on subsistence uses, travel corridors, and seasonally concentrated fish and wildlife resources. c. The location of oil and gas facilities, including artificial islands, platforms, associated pipelines, ice or other roads, bridges or causeways, shall be sited and constructed so as to not pose a hazard to navigation by the public using traditional high-use subsistence-related travel routes into and through the major coastal waterbodies, as identified by the NSB. d. Demonstrated year-round oil spill response capability, including the capability of adequate response during periods of broken ice or open water, or the availability of alternative methods to prevent well blowouts during periods when adequate response capability cannot be demonstrated. Such alternative methods may include seasonal drilling restrictions, improvements in blowout prevention technology, equipment and/or changes in operational procedures, and "top-setting" wells above the hydrocarbon-bearing zone. e. Reasonable efforts shall be made to avoid or minimize impacts related to oil spill response activities, including vessel, aircraft, and pedestrian traffic that add to impacts or further compound direct spill-related impacts on area resources and subsistence uses. f. Before conducting open water activities, the permittee shall consult with the Alaska Eskimo Whaling Commission and the NSB to minimize impacts on the fall and spring subsistence whaling activities of the communities of the North Slope.

Alternative A	Alternative B	Alternative C	Alternative D
(see above)	*(see above)*	and the NSB to minimize impacts on the fall and spring subsistence whaling activities of the communities of the North Slope.	*(see above)*
K-5 Coastal Area Setback • No surface occupancy • No new infrastructure, except essential coastal infrastructure (see ROP for essential coastal infrastructure) • Sand and gravel mining authorized on a case-by-case basis Note: This measure would be applied to relevant new leases. On lands unavailable for leasing, K-5 would be a BMP. Objective: Protect coastal waters and their value as fish and wildlife habitat (including, but not limited to, that for waterfowl, shorebirds, and marine mammals), minimize hindrance or alteration of caribou movement within caribou coastal insect-relief areas; protect the summer and winter shoreline habitat for polar bears and the summer shoreline habitat for walruses and seals; prevent loss of important bird habitat and alteration or disturbance of shoreline marshes and prevent impacts on subsistence resources and activities. Requirement/Standard: a. Exploratory well drill pads, production well drill pads, or a central processing facility for oil or gas would not be allowed in coastal waters or on islands between the northern boundary of the Reserve and the mainland, or in inland areas within one mile of the coast. (Note: This would include the entirety of the Kasegaluk Lagoon and Peard Bay Special Areas.) Other facilities necessary for oil and gas production within NPR-A that necessarily must be within this area (e.g., barge landing, seawater treatment plant, or spill response staging and storage areas) would not be precluded. Nor would this stipulation preclude infrastructure associated with offshore oil and gas exploration and production or construction, renovation, or replacement of facilities on existing gravel sites. Lessees/permittees shall consider the practicality of locating facilities that necessarily must be within this area at previously occupied sites, such as various Husky/U.S. Geological Survey drill sites and Distant Early Warning Line sites. All lessees/permittees involved in activities in the immediate area must coordinate use of these new or existing sites with all other prospective users. Before conducting open water activities, the lessee shall consult with the Alaska Eskimo Whaling Commission, the NSB, and local whaling captains associations to minimize impacts on the fall and spring subsistence whaling activities of the communities of the North Slope. In a case in which the BLM authorizes a permanent oil and gas facility within the Coastal Area, the lessee/permittee shall develop and implement a monitoring plan to assess the effects of the facility and its use on coastal habitat and use. b. Marine vessels used as part of a BLM-authorized activity shall maintain a 1-mile buffer from the shore when transiting past an aggregation of seals (primarily spotted seals) using a terrestrial haul-out, unless doing so would endanger human life or violate safe boating practices. Marine vessels shall not conduct ballast transfers or discharge any matter into the marine environment within 3 miles of the coast, except when necessary for the safe operation of the vessel. c. Marine vessels used as part of a BLM-authorized activity shall maintain a 0.5-mile buffer from shore when transiting past an aggregation of walruses using a terrestrial haul-out.	***K-5 Coastal Area Setback*** • No leasing • No new infrastructure, except essential coastal infrastructure (see ROP for essential coastal infrastructure) • Sand and gravel mining authorized on a case-by-case basis Objective: Same as Alternative A Requirement/Standard: No leasing is allowed within 1 mile of the coast. The following requirements apply to authorized activities within 1 mile of the coast. a. Permanent exploratory well drill pads, production well drill pads, or a central processing facility for oil or gas would not be allowed in coastal waters or on islands between the northern boundary of the Reserve and the mainland or in inland areas within 1 mile of the coast. (Note: This would include the entire Kasegaluk Lagoon and Peard Bay Special Areas.) Other facilities necessary for oil and gas production within the NPR-A that must be in this area, such as barge landing, seawater treatment plant, or spill response staging and storage areas, would not be precluded; however, in the Goose Molting Area, the AO must approve siting these facilities within the shoreline buffer. Nor would this stipulation preclude infrastructure associated with offshore oil and gas exploration and production or construction, renovation, or replacement of facilities on existing gravel sites. Except in the Goose Molting Area, lessees and permittees shall consider the practicality of locating facilities that necessarily must be at previously occupied sites in this area, such as various Husky/U.S. Geological Survey drill sites and Distant Early Warning Line sites. All lessees and permittees involved in activities in the immediate area must coordinate use of these new or existing sites with other prospective users. Before conducting open water activities, lessees shall consult with the Alaska Eskimo Whaling Commission, the NSB, and local whaling captain associations to minimize impacts on the fall and spring subsistence whaling activities of the North Slope communities. In a case in which the BLM authorizes a permanent oil and gas facility in the Coastal Area, the lessee or permittee shall develop and implement a monitoring plan to assess the effects of the facility and its use on coastal habitat and use. b. Marine vessels used as part of a BLM-authorized activity shall maintain a 1-mile buffer from the shore when transiting past an aggregation of seals (primarily spotted seals) using a terrestrial haul-out, unless doing so would endanger human life or violate safe boating practices. Marine vessels shall not conduct ballast transfers or discharge any matter into the marine environment within 3 miles of the coast, except when necessary for the safe operation of the vessel. c. Marine vessels used as part of a BLM-authorized activity shall maintain a 1-mile buffer from shore when transiting past an aggregation of walruses using a terrestrial haul-out.	***K-5 Coastal Area Setback*** • No surface occupancy • No new infrastructure, except essential coastal infrastructure (see ROP for essential coastal infrastructure) • Sand and gravel mining authorized on a case-by-case basis Objective: Same as Alternative A. Requirement/Standard: The following requirements apply to authorized activities within 1 mile of the coast. Same as Alternative B.	***K-5 Coastal Area Setback*** • No surface occupancy • No new infrastructure, except essential coastal infrastructure (see ROP for essential coastal infrastructure) • Sand and gravel mining authorized on a case-by-case basis Objective: Same as Alternative A. Requirement/Standard: The following requirements apply to authorized activities within 1 mile of the coast. Same as Alternative B.

Alternative A	Alternative B	Alternative C	Alternative D
K-6 BMP – Goose Molting Area • No Leasing • BMP for new infrastructure • Sand and gravel mining authorized on a case-by-case basis Note: Except for less than 10,000 acres east of the mouth of the Ikpikpuk River, new non-subsistence infrastructure would be prohibited in the goose molting area. None of the area is available for oil and gas leasing or exploratory drilling. Objective: Minimize disturbance to molting geese and loss of goose molting habitat in and around lakes in the Goose Molting Area. Requirement/Standard (General): Within the Goose Molting Area no permanent oil and gas facilities, except for pipelines, would be allowed within 1 mile of the shoreline of goose molting lakes. No waiver, exception, or modification would be considered. Prior to the permitting of a pipeline in the Goose Molting Area, a workshop would be convened to determine the best corridor for pipeline construction in efforts to minimize impacts on wildlife and subsistence resources. The workshop participants would include but would not be limited to federal, state, and NSB representatives. In addition, only "in field" roads would be authorized as part of oil and gas field development. Requirement/Standard (Development): In the Goose Molting Area, the following standards would be followed for permitted activities: a. Within the Goose Molting Area from June 15 through August 20, all off-pad activities and major construction activities using heavy equipment (e.g., sand/gravel extraction and transport, pipeline and pad construction, but not drilling from existing production pads) shall be suspended (see also BMP K-9(d)), unless approved by the AO, in consultation with the appropriate federal, State, and NSB regulatory and resource agencies. The intent of this requirement is to restrict activities that would disturb molting geese during the period when geese are present. b. Water extraction from any lakes used by molting geese shall not alter hydrological conditions that could adversely affect identified goose-feeding habitat along lakeshore margins. Considerations would be given to seasonal use by operators (generally in winter) and geese (generally in summer), as well as recharge to lakes from the spring snowmelt. c. Oil and gas activities would avoid altering (i.e., damage or disturbance of soils, vegetation, or surface hydrology) critical goose-feeding habitat types along lakeshore margins (grass/sedge/moss) and salt marsh habitats. d. Permanent oil and gas facilities (including gravel roads, pads, and airstrips, but excluding pipelines) and material sites would be sited outside the identified buffers and restricted surface occupancy areas. Additional limits on development footprint would apply. e. Between June 15 and August, 20 within the Goose Molting Area, oil and gas facilities shall incorporate features (e.g., temporary fences, siting/orientation) that screen/shield human activity from view of any Goose Molting Area lake, as identified by the AO, in consultation with appropriate federal, State, and NSB regulatory and resource agencies. f. Strategies to minimize ground traffic shall be implemented from June 15 through August 20. These strategies may include limiting trips, use of convoys, different vehicle types, etc. to the extent practicable. The permittee shall submit with the development proposal a vehicle use plan that considers these	***K-6 Goose Molting Area*** • No Leasing • No new infrastructure • Sand and gravel mining authorized on a case-by-case basis Objective: Minimize disturbance to molting geese and loss of goose molting habitat in and around lakes in the Goose Molting Area. Requirement/Standard (General): Within the Goose Molting Area no leasing and no new infrastructure is permitted. The only exception is an identified corridor for a pipeline. In the Goose Molting Area, the following standards would be followed for permitted activities: a. From June 1 through August 20, all off-pad activities and major construction activities using heavy equipment, such as sand and gravel extraction and transport and pipeline and pad construction, but not drilling from existing production pads, shall be suspended (see also K-9(d)), unless approved by the AO, in consultation with the appropriate federal, State, and NSB regulatory and resource agencies. The intent of this requirement is to restrict activities that would disturb molting geese and nesting spectacled eiders when those species are present. b. Water extracted from any lakes used by molting geese shall not alter hydrological conditions that could adversely affect identified goose feeding habitat along lakeshore margins. Considerations would be given to seasonal use by operators (generally in winter) and geese (generally in summer), as well as recharge to lakes from the spring snowmelt. c. Oil and gas activities would avoid altering (i.e., damaging or disturbing soils, vegetation, or surface hydrology) critical goose-feeding habitat types along lakeshore margins (grass/sedge/moss), and salt marsh habitats. Permanent oil and gas facilities, including gravel roads, pads, and airstrips, but excluding pipelines, and material sites would be sited outside the identified buffers and restricted surface occupancy areas. d. Strategies to minimize ground traffic shall be implemented from June 1 through August 20. These strategies will be submitted as part of the vehicle use plan (**ROP M-1**) and may include limiting trips and usage of convoys and different vehicle types, to the extent practicable. In the Goose Molting Area, aircraft, including fixed-wing and helicopters, shall be restricted from June 1 through August 20, unless doing so endangers human life or violates safe flying practices. Restrictions may include limiting flights to two roundtrips a week and limiting flights to corridors established by the BLM after discussions with appropriate federal, State, and NSB regulatory and resource agencies. The permittee shall submit with the development proposal an aircraft use plan (**ROP F-2**) that considers these and other mitigation. (Note: This site-specific ROP is not intended to restrict flights necessary to survey wildlife in order to gain information necessary to meet the stated objective of the stipulations and ROPs; however, flights necessary to gain this information would be restricted to the minimum necessary to collect such data.)	***K-6 Goose Molting Area*** Same as Alternative B.	***K-6 Goose Molting Area*** • Controlled surface use/timing limitations • ROP for new infrastructure • Sand and gravel mining authorized on a case-by-case basis Objective: Same as Alternative B. Requirement/Standard: In the Goose Molting Area, the following standards would be followed for permitted activities: Same as Alternative B

Alternative A	Alternative B	Alternative C	Alternative D
and any other mitigation. The vehicle use plan shall also include a vehicle use monitoring plan. Adjustments would be required by the AO if resulting disturbance is determined to be unacceptable. g. Within the Goose Molting Area aircraft use (including fixed-wing and helicopter) shall be restricted from June 15 through August 20, unless doing so endangers human life or violates safe flying practices. Restrictions may include: (1) limiting flights to two roundtrips/week, and (2) limiting flights to corridors established by the BLM after discussions with appropriate federal, State, and NSB regulatory and resource agencies. The permittee shall submit with the development proposal an aircraft use plan that considers these and other mitigation. The aircraft use plan shall also include an aircraft monitoring plan. Adjustments, including perhaps suspension of all aircraft use, would be required by the AO if resulting disturbance is determined to be unacceptable. Note: This site-specific BMP is not intended to restrict flights necessary to survey wildlife to gain information necessary to meet the stated objective of the stipulations and BMPs; however, flights necessary to gain this information would be restricted to the minimum necessary to collect such data. h. Any permit for development issued under this IAP/EIS would include a requirement for the permittee to conduct monitoring studies necessary to adequately determine consequences of development and any need for change to mitigations. Monitoring studies would be site- and development-specific within a set of overarching guidelines developed by the BLM after conferring with appropriate federal, State, NSB agencies. The studies would include the construction period and would continue for a minimum of 3 years after construction has been completed and production has begun. The monitoring studies would be a continuation of evaluating the effectiveness of BMP K-6's requirements in meeting the objective of K-6 and determine if any changes to the BMP or any project specific mitigation(s) are necessary. If changes are determined to be necessary, the BLM, with the permittee and/or their representative, would conduct an assessment of the feasibility of altering development operation (e.g., reduced human activity, visibility barriers, noise abatement). Any changes determined necessary would be implemented prior to authorization of any new construction.	e. For permits for development issued under this IAP/EIS, BLM may require the permittee to conduct monitoring studies necessary to adequately determine consequences of development and any need for change to mitigations. Monitoring studies would be site- and development-specific and would be within a set of over-arching guidelines developed by the BLM after conferring with appropriate federal, State, and NSB agencies.	*(see above)*	*(see above)*
No similar requirement. **See K-6** (Goose Molting Area)	No similar requirement. **See K-6** (Goose Molting Area)	No similar requirement. **See K-6** (Goose Molting Area)	***K-7 Protection for Goose Molting Lakes*** • No surface occupancy • No new infrastructure, except for essential pipeline crossings • Sand and gravel mining authorized on a case-by-case basis Objective: Minimize disturbance to molting geese within Goose Molting Area. Requirement/Standard: Within the Goose Molting Area, no permanent oil and gas facilities, except for pipelines, would be allowed within 0.5 mile of the shoreline of selected lakes. Lakes were selected based on the 85% distribution of black brant within the Goose Molting Area. No waiver, exception, or modification would be considered, except for community infrastructure projects. Prior to the permitting of a pipeline in the Goose Molting Area, a workshop would be convened to determine the best corridor for pipeline construction in efforts to minimize impacts on wildlife and

Alternative A	Alternative B	Alternative C	Alternative D
(see above)	*(see above)*	*(see above)*	subsistence resources. The workshop participants would include but would not be limited to federal, state, and NSB representatives. In addition, only “in field” roads would be authorized as part of oil and gas field development.
K-8 BMP—Brant Survey Area • No leasing • ROP for new infrastructure • Sand and gravel mining authorized on a case-by-case basis Objective: Minimize the loss or alteration of habitat for, or disturbance of, nesting and brood rearing brant in the Brant Survey Area. Requirement/Standard: a. Aerial surveys for brant nesting colonies and brood-rearing areas shall be conducted for a minimum of 2 years before authorization of construction of permanent facilities. At a minimum, the survey area shall include the proposed development site(s) (i.e., the footprint) and the surrounding 0.5-mile area. These surveys shall be conducted following accepted BLM protocol. b. Development may be prohibited or activities curtailed within 0.5 miles of all identified brant nesting colonies and brood-rearing areas identified during the 2-year survey.	***K-8 Brant Survey Area*** • No leasing • No new infrastructure • Sand and gravel mining authorized on a case-by-case basis Objective: Minimize the loss or alteration of habitat for, or disturbance of, nesting and brood rearing brant in the Brant Survey Area. Requirement/Standard: Same as Alternative A, where applicable. Otherwise, the area is not available for leasing or new infrastructure.	***K-8 Brant Survey Area*** • No surface occupancy • ROP for new infrastructure • Sand and gravel mining authorized on a case-by-case basis Objective: Minimize the loss or alteration of habitat for, or disturbance of, nesting and brood rearing brant in the Brant Survey Area. Requirement/Standard: The Brant Survey Area is open to oil and gas leasing, subject to a no surface occupancy stipulation. New infrastructure would be allowed on a case-by-case basis, subject to the requirements below. The following requirements apply: a. The BLM will require aerial surveys for brant nesting colonies and brood-rearing areas for a minimum of 2 years before construction of permanent facilities is authorized. At a minimum, the survey area shall include the proposed development sites (i.e., the footprint) and the surrounding 0.5-mile area. The permittee may be required to gather this data, or this requirement may be waived if an acceptable dataset (i.e., FWS aerial surveys) already exists and is approved by the AO. b. Development may be prohibited or activities curtailed within 0.5 miles of all identified brant nesting colonies and brood-rearing areas identified during the 2-year survey. c. In the Brant Survey Area from June 1 through August 20, all off-pad activities and major construction activities using heavy equipment, such as that for sand and gravel extraction and transport and pipeline and pad construction, but not for drilling from existing production pads, shall be suspended (see also K-9(d)), unless approved by the AO, in consultation with the appropriate federal, State, and NSB regulatory and resource agencies. The intent of this requirement is to restrict activities that would disturb nesting and brood-rearing brant when they are present. d. Water extraction from any lakes used by nesting and brood-rearing brant shall not alter hydrological conditions that could adversely affect identified brant feeding habitat along lakeshore margins. Consideration should be given to seasonal use by operators (generally in winter) and brant (generally in summer), as well as recharge to lakes from the spring snowmelt. e. Oil and gas activities would avoid altering, such as damaging or disturbing soils, vegetation, or surface hydrology, in critical brant-feeding habitat types along lakeshore margins (grass/sedge/moss) and salt marsh habitats. f. Strategies to minimize ground traffic shall be implemented from June 1 through August 20. These strategies may include limiting trips, use of convoys, different vehicle types, to the extent practicable. Strategies will be outlined in the vehicle use plan (see **ROP M-1**) g. In the Brant Survey Area, aircraft use, (including fixed-wing and helicopter, shall be restricted from June 1	***K-8 Brant Survey Area*** • Controlled surface use/timing limitations • ROP for new infrastructure • Sand and gravel mining authorized on a case-by-case basis Objective: Minimize the loss or alteration of habitat for, or disturbance of, nesting and brood rearing brant in the Brant Survey Area. Requirement/Standard: The Brant Survey Area is open to oil and gas leasing, subject to controlled surface use and timing limitations stipulations listed below. New infrastructure would be allowed on a case-by-case basis, subject to the requirements below. The following requirements apply: Same as Alternative C.

Alternative A	Alternative B	Alternative C	Alternative D
(see above)	*(see above)*	through August 20, unless doing so endangers human life or violates safe flying practices. Restrictions may include limiting flights to two roundtrips per week and limiting flights to corridors established by the BLM after discussions with appropriate federal, State, and NSB regulatory and resource agencies. Note: This site-specific ROP is not intended to restrict flights to survey wildlife to gain information necessary to meet the stated objective of the stipulations and ROPs; however, such flights would be restricted to the minimum necessary to collect such data. h. For permits for development issued under this IAP/EIS, BLM may include a requirement for the permittee to conduct monitoring studies necessary to adequately determine consequences of development and any need for change to mitigations. Monitoring studies would be site- and development-specific within a set of overarching guidelines developed by the BLM after conferring with appropriate federal, State, and NSB agencies.	*(see above)*
K-9 Teshekpuk Caribou Herd Habitat Area Note: None of the area is available for oil and gas leasing or exploratory drilling; therefore, K-9 would apply as a BMP. Portions of K-9 that apply to be permanent infrastructure are only relevant to the portion of the TCH Habitat Area available to application for such infrastructure, i.e., to those areas outside of the approximately 1.1 million acres near the lake where no new non-subsistence permanent infrastructure would be permitted. Objective: Minimize disturbance and hindrance of caribou or alteration of caribou movements through portions the TCH Habitat Area that are essential for all-season use, including calving and rearing, insect-relief, and migration. Requirement/Standard: In the TCH Habitat Area the following standards would be applied to permitted activities: a. Before authorization of construction of permanent facilities (limited as they may be by surface occupancy restrictions established in this decision), the permittee shall design and implement and report a study of caribou movement, unless an acceptable study specific to the TCH has been completed within the last 10 years. The study shall include a minimum of 4 years of current data on the TCH movements, and the study design shall be approved by the AO in consultation with the appropriate federal, State, and NSB wildlife and resource agencies. The study should provide information necessary to determine facility (including pipeline) design and location. Permittee may submit individual study proposals or may combine with other permittees in the area to do a single, joint study for the entire TCH Habitat Area. Study data may be gathered concurrently with other activities, as approved by the AO and in consultation with the appropriate federal, State, and NSB wildlife and resource agencies. A final report of the study results shall be prepared and submitted. Prior to the permitting of a pipeline in the TCH Habitat Area, a workshop shall be convened to identify the best corridor for pipeline construction in efforts to minimize impacts on wildlife (specifically the TCH) and subsistence resources. The workshop participants would include but would not be limited to federal, State, and NSB representatives. All of these modifications would increase protection for caribou and other	***K-9 Teshekpuk Caribou Herd Habitat Area*** - No leasing (Teshekpuk Lake Special Area) - No new infrastructure (Teshekpuk Lake Special Area), except for linear features within the identified corridor. Features within the corridor must follow the ROP identified in K-8. - Sand and gravel mining authorized on a case-by-case basis Objective: Minimize disturbance and hindrance of caribou or alteration of caribou movements through portions of the TCH Habitat Area that are essential for all-season use, including calving and rearing, insect-relief, and migration/movements. Requirement/Standard: No new leasing is allowed in the Teshekpuk Lake Special Area. No new infrastructure is allowed, except for linear ROWs within the identified corridor. Permitted activities will comply with the following requirements: In the TCH Habitat Area (the 75% parturient calving kernel) the following standards would be applied to permitted activities: b. Before authorization of construction of permanent facilities, the BLM will require a study of caribou movement for the TCH. The permittee may be required to conduct this study, or this requirement may be waived if an acceptable study specific to the TCH has been completed within the last 10 years and is approved for use by the AO. The study shall include a minimum of 4 years of current data on the TCH movements, and the study design shall be approved by the AO in consultation with the appropriate federal, State, and NSB wildlife and resource agencies. The study should provide information necessary to determine facility design and location, including pipelines. Permittee may submit individual study proposals or may combine with other permittees in the area to do a single, joint study for the entire TCH Habitat Area (the 75% calving caribou kernel). Study data may be gathered concurrently with other activities as approved by the AO and in consultation with the appropriate federal, State, and NSB wildlife and resource agencies. A final	***K-9 Teshekpuk Caribou Herd Habitat Area*** - No leasing (Teshekpuk Lake core area)/ no surface occupancy (50% parturient[2] calving kernel)/timing limitations (75% parturient calving kernel) - No new infrastructure (Teshekpuk Lake core area)/ROP for new infrastructure (75% parturient calving kernel) - Sand and gravel mining authorized on a case-by-case basis Objective: Same as Alternative B. Requirement/Standard: The Teshekpuk Lake core area is unavailable for leasing and closed to new infrastructure, except for linear ROWs within the identified corridor. The 50% parturient calving kernel is open to leasing subject to a no surface occupancy stipulation. Permitted activities will comply with the following requirements: Same as Alternative B.	***K-9 Teshekpuk Caribou Herd Habitat Area*** - No surface occupancy (3-mile lake buffer north; 1-mile lake buffer south)/timing limitations (75% parturient calving kernel) - No new infrastructure (3-mile lake buffer north; 1-mile lake buffer south)/ROP for new infrastructure (75% parturient calving kernel) - Sand and gravel mining authorized on a case-by-case basis Objective: Same as Alternative B. Requirement/Standard: Federal mineral estate within 3 miles of Teshekpuk Lake, except for the southern shore, is open to leasing, subject to a no surface occupancy stipulation. Federal mineral estate within 1 mile of the southern shore of Teshekpuk Lake is open to leasing, subject to a no surface occupancy stipulation. No exceptions, waivers, or modifications would be permitted. Permitted activities will comply with the following requirements: Same as Alternative B.

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[2] In labor.

Alternative A	Alternative B	Alternative C	Alternative D
wildlife that utilize the TCH Habitat Area during all seasons. b. Within the TCH Habitat Area, permittee shall orient linear corridors when laying out oil and gas field developments to address migration and corralling effects and to avoid loops of road and/or pipelines that connect facilities. c. Ramps over pipelines, buried pipelines, or pipelines buried under the road may be required by the AO, after consultation with appropriate federal, State, and NSB regulatory and resource agencies in the TCH Habitat Area where pipelines potentially impede caribou movement. d. Major construction activities using heavy equipment (e.g., sand/gravel extraction and transport, pipeline and pad construction, but not drilling from existing production pads) shall be suspended within TCH Habitat Area from May 20 through August 20, unless approved by the AO in consultation with the appropriate federal, State, and NSB regulatory and resource agencies. The intent of this requirement is to restrict activities that would disturb caribou during calving and insect-relief periods. If caribou arrive on the calving grounds prior to May 20, major construction activities would be suspended. The permittee shall submit with the development proposal a stop work plan that considers this and any other mitigation related to caribou early arrival. The intent of this latter requirement is to provide flexibility to adapt to changing climate conditions that may occur during the life of fields in the region. e. The following ground and air traffic restrictions shall apply in the areas and time periods indicated. Ground traffic restrictions apply to permanent oil and gas-related roads: • Within the TCH Habitat Area, from May 20 through August 20, traffic speed shall not exceed 15 miles per hour when caribou are within 0.5 miles of the road. Additional strategies may include limiting trips, using convoys, using different vehicle types, etc., to the extent practicable. The permittee shall submit with the development proposal a vehicle use plan that considers these and any other mitigation. The vehicle use plan shall also include a vehicle use monitoring plan. Adjustments would be required by the AO if resulting disturbance is determined to be unacceptable. • The permittee or a contractor shall observe caribou movement from May 20 through August 20, or earlier if caribou are present prior to May 20. Based on these observations, traffic would be stopped: 1) Temporarily to allow a crossing by 10 or more caribou. Sections of road would be evacuated whenever an attempted crossing by a large number of caribou appears to be imminent. The permittee shall submit with the development proposal a vehicle use plan that considers these and any other mitigation. 2) By direction of the AO throughout a defined area for up to 4 weeks to prevent displacement of calving caribou. 3) The vehicle use plan shall also include a vehicle use monitoring plan. Adjustments would be required by the AO if resulting disturbance is determined to be unacceptable. • Major equipment, materials, and supplies to be used at oil and gas work sites in the TCH Habitat Area shall be stockpiled prior to or after the period of May 20 through August 20 to minimize road traffic during that period.	b. report of the study results would be prepared and submitted. c. Prior to the permitting of a pipeline in the TCH Habitat Area (the 75% parturient calving kernel), a workshop would be convened to identify the best corridor for pipeline construction in efforts to minimize impacts on wildlife (specifically the TCH Herd) and subsistence resources. The workshop participants would include but would not be limited to federal, State, and NSB representatives. d. Within the TCH Habitat Area (the 75% parturient calving kernel), permittee shall orient linear corridors when laying out oil and gas field developments to address migration and corralling effects and to avoid loops of road and/or pipeline that connect facilities. e. Major construction activities using heavy equipment (e.g., sand/gravel extraction and transport, pipeline and pad construction, but not drilling from existing production pads) shall be suspended within TCH Habitat Area (the 75% parturient calving kernel) from May 20 through August 20, unless approved by the AO in consultation with the appropriate federal, State, and NSB regulatory and resource agencies. The intent of this requirement is to restrict activities that would disturb caribou during calving and insect-relief periods. If caribou arrive on the calving grounds prior to May 20, major construction activities would be suspended. The permittee shall submit with the development proposal a stop work plan that considers this and any other mitigation related to caribou early arrival. The intent of this latter requirement is to provide flexibility to adapt to changing climate conditions that may occur during the life of fields in the region. f. The following ground traffic restrictions shall apply in the areas and time periods indicated. Ground traffic restrictions apply to permanent oil and gas-related roads: • Within the TCH Habitat Area (the 75% parturient calving kernel), from May 20 through August 20, traffic speed shall not exceed 15 miles per hour when caribou are within ½ mile of the road. Additional strategies may include limiting trips, using convoys, using different vehicle types, etc., to the extent practicable. The permittee shall submit with the development proposal a vehicle use plan (see **ROP M-1)** that considers these and any other mitigation. • The permittee or a contractor shall observe caribou movement from May 20 through August 20, or earlier if caribou are present prior to May 20. Based on these observations, traffic would be stopped: 1) Temporarily to allow a crossing by 10 or more caribou. Sections of road would be evacuated whenever an attempted crossing by a large number of caribou appears to be imminent. The permittee shall submit with the development proposal a vehicle use plan that considers these and any other mitigation. 2) By direction of the AO throughout a defined area for up to 4 weeks to prevent displacement of calving caribou. • Major equipment, materials, and supplies to be used at oil and gas work sites in the TCH Habitat Area (the 75% parturient calving kernel) shall be stockpiled prior to or after the period of May 20 through August 20 to	*(see above)*	*(see above)*

Alternative A	Alternative B	Alternative C	Alternative D
(see above)	- minimize road traffic during that period. g. See ROPs F-2 through F-4 for aircraft restrictions.	*(see above)*	*(see above)*
K-10 Teshekpuk Caribou Herd Movement Corridor - No leasing - No new infrastructure/ROP for new infrastructure - Sand and gravel mining authorized on a case-by-case basis Note: None of the area is available for oil and gas leasing or exploratory drilling; therefore, K-10 would apply as a BMP. All of the former movement corridor northwest of Teshekpuk Lake and all but the easternmost part of the other corridor that lies north of the Kogru River are within an area prohibiting new non-subsistence infrastructure; therefore, this BMP only applies to the lands in the former corridor north of the Kogru River in Ts. 14-15 N., R. 2 W., U.M. Objective: Minimize disturbance and hindrance of caribou or alteration of caribou movements (that are essential for all-season use, including calving and rearing, insect-relief, and migration) in the area extending from the eastern shore of Teshekpuk Lake eastward to the Kogru River. Requirement/Standard: Within the TCH Movement Corridor, no permanent oil and gas facilities, except for pipelines or other infrastructure associated with offshore oil and gas exploration and production, would be allowed. Prior to the permitting of permanent oil and gas infrastructure in the Caribou Movement Corridor, a workshop would be convened to identify the best corridor for pipeline construction in efforts to minimize impacts on wildlife and subsistence resources. The workshop participants would include but would not be limited to federal, State, and NSB representatives.	***K-10 Teshekpuk Caribou Herd Movement Corridor*** - No leasing (Teshekpuk Lake Special Area) - No new infrastructure (Teshekpuk Lake Special Area), except for linear features within the identified corridor, which must follow the ROP identified in **K-8**. - Sand and gravel mining authorized on a case-by-case basis Objective: Minimize disturbance and hindrance of caribou or alteration of their movements that are essential for all-season use, including calving and rearing, insect-relief, and migration, in the area extending from the eastern shore of Teshekpuk Lake to approximately 6 miles eastward toward the Kogru Inlet and the area next to the northwest corner of Teshekpuk Lake. Requirement/Standard: In the Caribou Movement Corridors, a no surface occupancy stipulation would be applied and no permanent oil and gas facilities, except for pipelines, would be allowed. Before a pipeline in the Caribou Movement Corridors is permitted, a workshop would be convened to identify the best corridor for pipeline construction in efforts to minimize impacts on wildlife and subsistence resources. The workshop participants would include but would not be limited to federal, state, and NSB representatives.	***K-10 Teshekpuk Caribou Herd Movement Corridor*** - No leasing (Teshekpuk Lake core area)/ no surface occupancy (50% parturient calving kernel)/timing limitations (75% parturient calving kernel) - No new infrastructure (Teshekpuk Lake core area)/ROP for new infrastructure (75% parturient calving kernel) - Sand and gravel mining authorized on a case-by-case basis Objective: Same as Alternative B. Requirement/Standard: Same as Alternative B.	***K-10 Teshekpuk Caribou Herd Movement Corridor*** - No surface occupancy - No new infrastructure, except pipelines - Sand and gravel mining authorized on a case-by-case basis Objective: Same as Alternative B. Requirement/Standard: Same as Alternative B.
K-11 BMP – Southern Caribou Calving Area Note: None of the area is available for oil and gas leasing or exploratory drilling; therefore, K-11 would apply as a BMP. All but the easternmost part of the former Southern Caribou Calving Area lies within an area prohibiting new non-subsistence infrastructure; therefore, this BMP only applies to the lands in the former area T. 14 N., Rs. 1-2 W., U.M.; T. 14 N., R. 1 E., U.M; and T. 15 N., R. 2 W., U.M. Objective: Minimize disturbance and hindrance of caribou or alteration of caribou movements (that are essential for all season use, including calving and post calving, and insect-relief) in the area south-southeast of Teshekpuk Lake. Requirement/Standard: Within the Southern Caribou Calving Area, no permanent oil and gas facilities, except pipelines or other infrastructure associated with offshore oil and gas exploration and production, would be allowed. Prior to the permitting of permanent oil and gas infrastructure in the Southern Caribou Calving Area, a workshop would be convened to identify the best corridor for pipeline construction in efforts to minimize impacts on wildlife and subsistence resources. The workshop participants would include but would not be limited to federal, State, and NSB representatives.	No similar requirement; see K-1, K-4, and K-9.	No similar requirement; see K-1, K-4, and K-9.	No similar requirement; **see K-1, K-4, K-9, and ROP E-23** (Infrastructure Siting Near Teshekpuk Lake)
K-12 Colville River Special Area Note: This measure would be applied to relevant new leases. On lands unavailable for leasing, K-12 would be a BMP. Objective: Prevent or minimize loss of raptor foraging habitat (also see K-1). Requirement/Standard: If necessary to construct permanent facilities within the Colville River Special Area, all reasonable and practicable efforts shall be made to locate permanent facilities as far from raptor	No similar requirement.	No similar requirement.	No similar requirement.

Alternative A	Alternative B	Alternative C	Alternative D
nests as feasible. Additionally, within 15 miles of raptor nest sites, significant alteration of high-quality foraging habitat shall be prohibited, unless the lessee can demonstrate on a site-specific basis that impacts would be minimal. Of particular concern are ponds, lakes, wetlands, and riparian habitats. Note: On a case-by-case basis, and in consultation with appropriate federal and State regulatory and resource agencies, essential pipeline and road crossings would be permitted through the Colville River Special Area where no other feasible or prudent options are available.	*(see above)*	*(see above)*	*(see above)*
K-13 Pik Dunes • No leasing • ROP for new infrastructure • Sand and gravel mining authorized on a case-by-case basis Note: None of the area is available for oil and gas leasing or exploratory drilling; therefore, K-13 would apply as a BMP. Objective: Retain unique qualities of the Pik Dunes, including geologic and scenic uniqueness, insect-relief habitat for caribou, and habitat for several uncommon plant species. Requirement/Standard: Surface structures, except approximately perpendicular pipeline crossings and ice pads, are prohibited within the Pik Dunes.	***K-13 Pik Dunes*** • No leasing • No new infrastructure • Sand and gravel mining authorized on a case-by-case basis Objective: Same as Alternative A. Requirement/Standard: Surface structures, except approximately perpendicular pipeline crossings and ice pads, are prohibited in the Pik Dunes. Operators shall conduct a plant survey prior to constructing an ice pad and shall avoid construction where special status plant species are identified.	***K-13 Pik Dunes*** • No surface occupancy • No new infrastructure • Sand and gravel mining authorized on a case-by-case basis Objective: Same as Alternative A. Requirement/Standard: Same as Alternative B.	Same as Alternative C.
K-14 Utukok River Uplands Special Area • No leasing, except northernmost portion of Special Area • No new infrastructure, except northernmost portion of Special Area sand and gravel mining authorized on a case-by-case basis Note: This measure would be applied to relevant new leases. On lands unavailable for leasing, K-14 would be a BMP. Portions of K-14 that apply to permanent infrastructure are only relevant to the northern portion of the Utukok River Uplands Special Area available to application for such infrastructure. Objective: Minimize disturbance and hindrance of caribou or alteration of caribou movements through the Utukok River Uplands Special Area that are essential for all-season use, including calving and rearing, insect-relief, and migration. Requirement/Standard: In the Utukok River Uplands Special Area, the following standards would be applied to permitted activities: a. Before authorization of construction of permanent facilities, the lessee shall design and implement and report a study of caribou movement, unless an acceptable study specific to the Western Arctic Herd has been completed within the last 10 years. The study shall include a minimum of 4 years of current data on the Western Arctic Herd's movements, and the study design shall be approved by the AO, in consultation with the appropriate federal, State, and NSB wildlife and resource agencies and the Western Arctic Caribou Herd Working Group. The study should provide information necessary to determine facility (including pipeline) design and location. Lessees may submit individual study proposals or they may combine with other lessees in the area to do a single, joint study for the entire Utukok River Uplands Special Area. Study data may be gathered concurrently with other activities, as approved by the AO and in consultation with the appropriate federal, State, and NSB wildlife and resource agencies. A final report of the study results would be prepared and submitted. Prior to the permitting of a pipeline in the Utukok River	***K-14 Utukok River Uplands Special Area*** • No leasing • No new infrastructure • Sand and gravel mining authorized on a case-by-case basis Objective: Same as Alternative A. Requirement/Standard: No new leasing and no new infrastructure in the Utukok River Uplands Special Area.	***K-14 Utukok River Uplands Special Area*** • No leasing (Western Arctic Herd core calving area) • No new infrastructure (Western Arctic Herd core calving area) • Sand and gravel mining authorized on a case-by-case basis Objective: Same as Alternative A. Requirement/Standard: No new leasing and no new infrastructure in the Western Arctic Herd core calving area in the Utukok River Uplands Special Area. In the Utukok River Uplands Special Area, the following standards would be applied to permitted activities: a. Before authorization of construction of permanent facilities, the BLM will require a study of caribou movement for the Western Arctic Caribou Herd. The permittee may be required to conduct this study, or this requirement may be waived if an acceptable study specific to the Western Arctic Caribou Herd has been completed within the last 10 years and is approved for use by the AO. The study shall include a minimum of 4 years of current data on the Western Arctic Herd's movements and the study design shall be approved by the AO, in consultation with the appropriate federal, State, and NSB wildlife and resource agencies and the Western Arctic Caribou Herd Working Group. The study should provide information necessary to determine facility (including pipeline) design and location. Lessees may submit individual study proposals or they may combine with other lessees in the area to do a single, joint study for the entire Utukok River Uplands Special Area. Study data may be gathered concurrently with other activities, as approved by the AO and in consultation with the appropriate federal, State, and NSB wildlife and resource agencies. A final report of the study results would be prepared and submitted. Prior to	***K-14 Utukok River Uplands Special Area*** Same as Alternative C.

Alternative A	Alternative B	Alternative C	Alternative D
Uplands Special Area, a workshop would be convened to identify the best corridor for pipeline construction in efforts to minimize impacts on wildlife (specifically the Western Arctic Herd) and subsistence resources. The workshop participants would include but would not be limited to federal, State, and NSB representatives. All of these modifications would increase protection for caribou and other wildlife that utilize the Utukok River Uplands Special Area during all seasons. b. Within the Utukok River Uplands Special Area, lessees shall orient linear corridors when laying out oil and gas field developments to address migration and corralling effects and to avoid loops of road and/or pipelines that connect facilities. c. Ramps over pipelines, buried pipelines, or pipelines buried under the road may be required by the AO, after consultation with appropriate federal, State, and NSB regulatory and resource agencies, in the Utukok River Uplands Special Area, where pipelines potentially impede caribou movement. d. Major construction activities using heavy equipment (e.g., sand/gravel extraction and transport, pipeline and pad construction, but not drilling from existing production pads) shall be suspended within Utukok River Uplands Special Area from May 20 through August 20, unless approved by the AO in consultation with the appropriate federal, State, and NSB regulatory and resource agencies. The intent of this requirement is to restrict activities that would disturb caribou during calving and insect-relief periods. If caribou arrive on the calving grounds prior to May 20, major construction activities would be suspended. The lessee shall submit with the development proposal a stop work plan that considers this and any other mitigation related to caribou early arrival. The intent of this latter requirement is to provide flexibility to adapt to changing climate conditions that may occur during the life of fields in the region. f. The following ground and air traffic restrictions shall apply to permanent oil and gas-related roads in the areas and time periods indicated: • Within the Utukok River Uplands Special Area, from May 20 through August 20, traffic speed shall not exceed 15 miles per hour when caribou are within 0.5 miles of the road. Additional strategies may include limiting trips, using convoys, using different vehicle types, etc., to the extent practicable. The lessee shall submit with the development proposal a vehicle use plan that considers these and any other mitigation. The vehicle use plan shall also include a vehicle use monitoring plan. Adjustments would be required by the AO if resulting disturbance is determined to be unacceptable. • The lessee or a contractor shall observe caribou movement from May 20 through August 20, or earlier if caribou are present prior to May 20. Based on these observations, traffic would be stopped: 1) Temporarily to allow a crossing by 10 or more caribou. Sections of road would be evacuated whenever an attempted crossing by a large number of caribou appears to be imminent. The lessee shall submit with the development proposal a vehicle use plan that considers these and any other mitigation. 2) By direction of the AO throughout a defined area for up to 4 weeks to prevent displacement of calving caribou. 3) The vehicle use plan shall also include a vehicle use monitoring plan. Adjustments would be required by the AO if resulting disturbance is determined to be unacceptable.	*(see above)*	the permitting of a pipeline in the Utukok River Uplands Special Area, a workshop would be convened to identify the best corridor for pipeline construction in efforts to minimize impacts on wildlife (specifically the Western Arctic Herd) and subsistence resources. The workshop participants would include but would not be limited to federal, State, and NSB representatives. All of these modifications would increase protection for caribou and other wildlife that utilize the Utukok River Uplands Special Area during all seasons. b. Within the Utukok River Uplands Special Area, lessees shall orient linear corridors when laying out oil and gas field developments to address migration and corralling effects and to avoid loops of road and/or pipeline that connect facilities. c. Ramps over pipelines, buried pipelines, or pipelines buried under the road may be required by the AO, after consultation with appropriate federal, State, and NSB regulatory and resource agencies, in the Utukok River Uplands Special Area where pipelines potentially impede caribou movement. d. Major construction activities using heavy equipment (e.g., sand/gravel extraction and transport, pipeline and pad construction, but not drilling from existing production pads) shall be suspended within Utukok River Uplands Special Area from May 20 through August 20, unless approved by the AO in consultation with the appropriate federal, State, and NSB regulatory and resource agencies. The intent of this requirement is to restrict activities that would disturb caribou during calving and insect-relief periods. If caribou arrive on the calving grounds prior to May 20, major construction activities would be suspended. The lessee shall submit with the development proposal a stop work plan that considers this and any other mitigation related to caribou early arrival. The intent of this latter requirement is to provide flexibility to adapt to changing climate conditions that may occur during the life of fields in the region. e. The following ground and air traffic restrictions shall apply to permanent oil and gas-related roads in the areas and time periods indicated: • Within the Utukok River Uplands Special Area, from May 20 through August 20, traffic speed shall not exceed 15 miles per hour when caribou are within 0.5 miles of the road. Additional strategies may include limiting trips, using convoys, using different vehicle types, etc., to the extent practicable. • The lessee or a contractor shall observe caribou movement from May 20 through August 20, or earlier if caribou are present prior to May 20. Based on these observations, traffic would be stopped: 1) Temporarily to allow a crossing by 10 or more caribou. Sections of road would be evacuated whenever an attempted crossing by a large number of caribou appears to be imminent. The lessee shall submit with the development proposal a vehicle use plan that considers these and any other mitigation. 2) By direction of the AO throughout a defined area for up to 4 weeks to prevent displacement of calving caribou.	*(see above)*

Alternative A	Alternative B	Alternative C	Alternative D
• Major equipment, materials, and supplies to be used at oil and gas work sites in the Utukok River Uplands Special Area shall be stockpiled prior to or after the period of May 20 through August 20 to minimize road traffic during that period. • Within the Utukok River Uplands Special Area aircraft use (including fixed-wing and helicopter) shall be restricted from May 20 through August 20, unless doing so endangers human life or violates safe flying practices. Authorized users of the NPR-A may be restricted from using aircraft larger than a Twin Otter and limited to an average of one fixed-wing aircraft takeoff and landing per day per airstrip, except for emergency purposes. Restrictions may include prohibiting the use of aircraft larger than a Twin Otter by authorized users of the NPR-A, including oil and gas lessees, from May 20 through August 20 within the Utukok River Uplands Special Area, except for emergency purposes. The lessee shall submit with the development proposal an aircraft use plan that considers these and other mitigation. The aircraft use plan shall also include an aircraft monitoring plan. Adjustments, including perhaps suspension of all aircraft use, would be required by the AO if resulting disturbance is determined to be unacceptable. This lease stipulation is not intended to restrict flights necessary to survey wildlife to gain information necessary to meet the stated objective of the stipulations and BMPs; however, flights necessary to gain this information would be restricted to the minimum necessary to collect such data. • Aircraft shall maintain a minimum height of 1,000 feet above ground level (except for takeoffs and landings) over caribou winter ranges from December 1 through May 1 and 2,000 feet above ground level over the Utukok River Uplands Special Area from May 20 through August 20, unless doing so endangers human life or violates safe flying practices. Caribou wintering ranges would be defined annually by the AO in consultation with the Alaska Department of Fish and Game. This lease stipulation is not intended to restrict flights necessary to survey wildlife to gain information necessary to meet the stated objective of the stipulations and BMPs; however, flights necessary to gain this information would be restricted to the minimum necessary to collect such data.	*(see above)*	• Major equipment, materials, and supplies to be used at oil and gas work sites in the Utukok River Uplands Special Area shall be stockpiled prior to or after the period of May 20 through August 20 to minimize road traffic during that period. • Within the Utukok River Uplands Special Area aircraft use (including fixed-wing and helicopter) shall be restricted from May 20 through August 20, unless doing so endangers human life or violates safe flying practices. Authorized users of the NPR-A may be restricted from using aircraft larger than a Twin Otter and limited to an average of one fixed-wing aircraft takeoff and landing per day per airstrip, except for emergency purposes. Restrictions may include prohibiting the use of aircraft larger than a Twin Otter by authorized users of the NPR-A, including oil and gas lessees, from May 20 through August 20 within the Utukok River Uplands Special Area, except for emergency purposes. The lessee shall submit with the development proposal an aircraft use plan (see **ROP F-2)** that considers these and other mitigation. This lease stipulation is not intended to restrict flights necessary to survey wildlife to gain information necessary to meet the stated objective of the stipulations and ROPs; however, flights necessary to gain this information would be restricted to the minimum necessary to collect such data. • Aircraft shall maintain a minimum height of 1,500 feet above ground level (except for takeoffs and landings) over caribou winter ranges from December 1 through May 1 and 1,500 feet above ground level over the Utukok River Uplands Special Area from May 20 through August 20, unless doing so endangers human life or violates safe flying practices. Caribou wintering ranges would be defined annually by the AO in consultation with the Alaska Department of Fish and Game. This lease stipulation is not intended to restrict flights necessary to survey wildlife to gain information necessary to meet the stated objective of the stipulations and ROPs; however, flights necessary to gain this information would be restricted to the minimum necessary to collect such data.	*(see above)*
No similar requirement.	***K-15: Federal Mineral Estate under Allotments*** • No surface occupancy (3 miles) • Sand and gravel mining authorized on a case-by-case basis Objective: Minimize disturbance to Native subsistence hunters resulting from development and ensure access to Native allotments. Requirement/Standard: Permanent oil and gas facilities within 3 miles of native allotments are prohibited, except for essential road and pipeline crossings in areas of overlapping setbacks. Exceptions would be considered in consultation with the owner of the allotment.	Same as Alternative B.	***K-15: Federal Mineral Estate under Allotments*** • No surface occupancy (1 mile) • Sand and gravel mining authorized on a case-by-case basis Objective: Minimize disturbance to Native subsistence hunters resulting from development and ensure access to Native allotments. Requirement/Standard: Permanent oil and gas facilities within 1 mile of native allotments are prohibited, except for essential road and pipeline crossings in areas of overlapping setbacks. Exceptions would be considered in consultation with the owner of the allotment.

Alternative A	Alternative B	Alternative C	Alternative D
No similar requirement.	***K-16: Lease Deferral around Nuiqsut*** • No leasing for at least 10 years Objective: Minimize the impact of rapid development on the community of Nuiqsut. Requirement/Standard: Lease tracts that are surrendered or currently unleased within the deferral area would not be offered for lease for at least 10 years after the signing of the ROD for this EIS. The deferral area encompasses land on the eastern edge of the NPR-A boundary. From the eastern NPR-A boundary, the deferral area extends westward to the principal meridian separating 1E and 1W in the Umiat Meridian. Five additional townships north of the Kalikpuk River (township line dividing 12W and 13W) are included to encompass most of the Kogru inlet; the townships are T13NR1W, T14NR1W, T13NR2W, T14NR2W, and T15NR2W.	No similar requirement.	No similar requirement.
K-17: Federal Mineral Estate under Native Lands • Available for leasing • Sand and gravel mining authorized on a case-by-case basis	***K-17: Federal Mineral Estate under Native Lands*** • No leasing • Sand and gravel mining authorized on a case-by-case basis	***K-17: Federal Mineral Estate under Native Lands*** • No surface occupancy • Sand and gravel mining authorized on a case-by-case basis	Same as Alternative A.
Wild and Scenic Rivers Manage the following suitable river segments to protect their free flow, water quality, and outstandingly remarkable qualities; no suitable river segments would be recommended for designation as a Wild and Scenic Rivers: • Colville River (where the BLM manages the bed and both banks) • Nigu River • Etivluk River • Ipnavik River • Kuna River • Kiligwa River • Nuka River • Awuna River • Kokolik River • Utukok River • Driftwater Creek • Carbon Creek	***Wild and Scenic Rivers*** Manage the following suitable river segments to protect their free flow, water quality, and outstandingly remarkable qualities and recommend them for designation as a Wild and Scenic Rivers: • Colville River (where the BLM manages the bed and both banks) • Nigu River • Etivluk River • Ipnavik River • Kuna River • Kiligwa River • Nuka River • Awuna River • Kokolik River • Utukok River • Driftwater Creek • Carbon Creek	Same as Alternative A.	Same as Alternative A.

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2.3 ALTERNATIVES CONSIDERED BUT ELIMINATED FROM DETAILED ANALYSIS

The BLM has considered alternatives in addition to those listed in **Section 2.2** but has determined to eliminate them from further consideration for the reasons provided below.

2.3.1 Wild and Scenic Rivers Eligibility and Suitability Studies

One scoping commenter suggested that the BLM undertake a Wild and Scenic Rivers eligibility and suitability study during the analysis. Section 5(d)(1) of the Wild and Scenic Rivers Act (Public Law 90-542; 16 U.S. Code 1271-1287) directs federal agencies to consider potential Wild and Scenic Rivers in their land and water planning processes ("In all planning for the use and development of water and related land resources, consideration shall be given by all federal agencies involved to potential national wild, scenic, and recreational river areas"). Furthermore, BLM Manual 6400, Chapter 4, Section 4.1(A) discusses existing evaluations, such as those that exist for the NPR-A. It says, "If a systematic evaluation of eligible rivers or a comprehensive administrative unit-wide suitability study has been previously completed and documented, additional assessment and study through the land use planning process need only be done if: (1) the documentation no longer exists or is incomplete or outdated; (2) changed circumstances warrant additional review of eligibility (e.g., new outstandingly remarkable value); (3) there is a change in the suitability factors; or (4) the AO decides to evaluate suitability for one or more eligible rivers in the land use planning process. Land use plans should address whether existing evaluations of eligible rivers or suitability studies will be revisited."

To fulfill the requirement of the Wild and Scenic Rivers Act, the BLM studied the rivers in the NPR-A during past IAP efforts. No changed circumstances warrant additional review of eligibility, and there has been no change in suitability factors. For these reasons, the BLM is not evaluating the potential eligibility or suitability of rivers for the National Wild and Scenic Rivers System in this analysis.

2.3.2 Designating New or Expanding Existing Special Area

Commenters suggested designating an Ikpikpuk Special Area, comprising about 240,000 acres along the southern portions of the Ikpikpuk River (its upper reaches) to protect inland birds and raptor habitat. This potential new special area was dismissed from further analysis because the BLM is already proposing protections under Alternative B that would protect habitat for species in this area. Alternative B would include a buffer on rivers to not allow oil and gas leasing or new infrastructure. Raptors would also have additional protections throughout the NPR-A under all action alternatives.

Commenters also requested that the BLM consider expanding existing special areas or designating additional special areas for marine mammals; however, the BLM dismissed from further analysis a new or expanded special area. This is because the proposed 1-mile buffer along the coast under all alternatives, combined with the proposed management for the Kasegaluk Lagoon and Peard Bay Special Areas, would protect marine mammals along the coast.

Commenters also requested that the BLM consider expanding existing special areas or designating additional special areas for molting geese; however, the BLM dismissed from further analysis a new or expanded special area. This is because the expansion of the Teshekpuk Lake Special Area (established in part to protect migrating waterfowl) in the 2013 IAP ROD was driven largely by the changing habits of molting geese, and this expansion is reflected in all alternatives. All alternatives propose management prescriptions for protecting molting geese in the Teshekpuk Lake Special Area through a variety of stipulations and ROPs.

Commenters also requested that the BLM consider expanding existing special areas or designating additional special areas to protect cliff-nesting raptors in the middle of the NPR-A; however, the BLM dismissed from further analysis a new or expanded special area for this purpose. This is because, under all action alternatives, the BLM is proposing stipulations and ROPs to protect cliff-nesting raptors throughout the entire NPR-A (see K-1 and ROPs A-8, E-8, E-16, and F-3), thus, designating a special area to protect raptors is not warranted (see **Section 2.2.1**).

Chapter 3. Affected Environment and Environmental Consequences

3.1 INTRODUCTION

This chapter combines the description of baseline environmental conditions and the analysis of environmental effects for each resource. Though these two aspects are often in separate chapters in an environmental impact statement (EIS), they are combined here to facilitate continuity for the reader from baseline conditions to potential effects on each resource. Following the description of baseline conditions, the discussion of direct and indirect, and cumulative impacts under each resource provides the scientific and analytic basis for evaluation of the potential effects of each of the alternatives described in **Chapter 2, Tables 2-2** and **2-3**. The approach to impact analysis is discussed further in **Appendix F**.

Issuance of oil and gas leases would have no direct impacts on the environment because by itself a lease does not authorize any on-the-ground oil and gas activities; however, a lease does grant the lessee certain rights to drill for and extract oil and gas subject to further environmental review and reasonable regulation, including applicable laws, terms, conditions, and stipulations of the lease. The impacts of such future exploration and development activities that may occur because of the issuance of leases are considered potential indirect impacts of leasing. Such post-lease activities could include seismic and drilling exploration, development, and transportation of oil and gas in and from the National Petroleum Reserve in Alaska (NPR-A) and refinement and consumption of produced oil. Therefore, the analysis of impacts resulting from leasing is of potential direct and indirect, and cumulative impacts on resources from on-the-ground, post-lease activities and related infrastructure development.

This integrated activity plan (IAP)/EIS also analyzes impacts of oil and gas activities not associated with a lease (e.g., seismic surveys of unleased areas and pipelines transporting oil and gas from offshore leases), as well as of non-oil and gas activities (e.g., construction of community infrastructure and scientific activities). For such activities, the analysis is of the direct and indirect, and cumulative impacts of the activities themselves. Further, only high-potential areas are considered to be reasonable targets for development at this time.

The Bureau of Land Management (BLM) has relied on the best available science to inform our consideration of the environmental impacts of BLM-managed activities in the NPR-A; however, the nature, abundance, and quality of the data often vary depending on the action, the geographic region in which they occur, and the environmental resources that may be affected, and all these variables influence our understanding of how certain activities may affect environmental resources and uses. When confronted with missing information, this EIS complies with 40 Code of Federal Regulations (CFR) 1502.22.

3.2 PHYSICAL ENVIRONMENT

3.2.1 Climate and Meteorology

Affected Environment

The NPR-A is classified as northern polar climate with long and cold winters, and short and cool summers. The annual average temperature in the NPR-A is approximately 10 degrees Fahrenheit with monthly average temperatures below freezing from October to May. Summer temperatures rise above freezing with the highest temperatures typically in July. Annual average precipitation in the NPR-A is low ranging from 3 inches near the coast to 13 inches inland. Precipitation is highest during summer with over three-fourths of the total annual precipitation falling between June and September. Though snowfall is sparser during the summer months, it can occur during any month with the highest average snowfall rates occurring in October. Additional information, including monthly data for temperature, precipitation, snowfall, and snow depth from monitoring stations used to characterize climate and meteorology in the NPR-A, is provided in **Table G-1**, **Appendix G**.

Factors Affecting Climate

Processes leading to climate change include natural processes, such as solar cycles or volcanic eruptions, or external forcing, such as persistent anthropogenic changes in the composition of the atmosphere or land use. Greenhouse gases warm the atmosphere by absorbing infrared radiation emitted from the Earth's surface. Major greenhouse gases from oil and gas development include carbon dioxide, methane, and nitrous oxide. Greenhouse gas emissions are reported in units of carbon dioxide equivalent emissions to account for the varying global warming potential of pollutants. Greenhouse gases are produced both naturally (e.g., volcanoes) and through anthropogenic activities (e.g., burning of fossil fuels). The Intergovernmental Panel on Climate Change has noted that anthropogenic emissions have driven atmospheric concentrations of greenhouse gases to levels unprecedented in the last 800,000 years (IPCC 2014). Black carbon, a byproduct of incomplete combustion, affects climate by absorbing and scattering solar radiation and indirectly by altering cloud properties (AMAP 2015; Xu et al. 2017). There is considerable uncertainty regarding the effect of black carbon on climate, as it can warm or cool the atmosphere, but the net effect is believed to be one of warming at +1.1 Watts per square meter (Bond et al. 2013).

Observed and Projected Climate Trends and Impacts in the Arctic and North Slope

Trends in global, United States (U.S.), and Alaska greenhouse gas emissions are described in **Appendix G**, **Section G.1.5**. Global warming impacts observed globally and nationally are amplified in the Arctic. Over the past 60 years, average annual air temperatures in the region have increased by 3 degrees Fahrenheit, and average winter temperatures have increased 6 degrees Fahrenheit (Melillo et al. 2014). Snow cover extent in 2017 was the lowest on record for April and May in the North American Arctic (Derksen et al. 2017). Warmer temperatures combined with reduced ice cover have led to greening of the tundra and increases in soil moisture and the amount of snow water available, which have led to increased active layer depth and changes in herbivore activity patterns (Clement et al. 2013; Epstein et al. 2017).

The North Slope has experienced increased average temperatures, decreased sea ice and snow cover extent, an expanded growing season, and thawing permafrost. Annual average temperatures in the North Slope are expected to be 12.4 degrees Fahrenheit to 21.2 degrees Fahrenheit by 2019, at least 3 degrees Fahrenheit higher than the annual average from 1961 to 1990 (SNAP 2018). The North Slope has shown substantial increases in tundra greenness from 1982 to 2016 (Richter-Menge et al. 2017). Permafrost observational sites had record high temperatures at a depth of 20 meters in 2016 on the North Slope. Long-term permafrost temperature monitoring shows a warming trend over the past 25 years, with the greatest warming near the coast. Soil temperatures increased 3 degrees Fahrenheit to 5 degrees Fahrenheit between 1985 and 2004 (USFWS 2015). As in the wider Arctic region, the snow and ice albedo feedback from black carbon is magnified in the North Slope.

The warming in Alaska is projected to continue with average annual air temperatures increasing 2 to 4 degrees Fahrenheit between 2021 and 2050 (Melillo et al. 2014). Temperatures on the North Slope are expected to increase by 10 to 12 degrees Fahrenheit if global emissions continue to increase during this century. In addition to predictions, National Oceanic and Atmospheric Administration also confirmed that

Alaska had the hottest month on record in July [2019] (NOAA 2019). Annual precipitation in Alaska is also projected to increase, with 15 to 30 percent more precipitation by late this century if global greenhouse gas emissions continue to increase (Melillo et al. 2014). However, based on historical data, precipitation may be more variable in the North Slope. Though there was a 10 percent increase in statewide average precipitation in Alaska between 1949 and 2005, precipitation in Utqiaġvik decreased 36 percent from 1949 to 1998 (Markon et al. 2012). Snow cover duration in Alaska is expected to decrease due to an earlier snowmelt and later date of first snowfall (Markon et al. 2012). Correspondingly, increases to the Alaskan growing season are also projected to continue (Melillo et al. 2014). This change will reduce water storage as well as increase the risk and extent of wildfires and insect outbreaks in the region. Warmer temperatures, wetland drying, and increased summer thunderstorms have increased the number of wildfires in Alaska. The annual area burned is projected to double by mid-century, releasing more carbon to the atmosphere (Melillo et al. 2014). Additional information on climate trends and impacts is provided in **Appendix G**, **Section G.1.6**.

Direct and Indirect Impacts

Alternative A – No Action Alternative

The impacts of greenhouse gas emissions from future oil and gas development in the NPR-A on climate change are likely to occur over several decades to a century and are difficult to quantify since they are a small fraction of annual U.S. and global greenhouse gas emissions, as discussed below. Therefore, greenhouse gas emissions are used as a proxy for understanding the potential impacts of future development on climate change. Greenhouse gas emissions would be generated by construction and operations of future oil and gas developments (“production greenhouse gas emissions”) and by refining and consumption of the produced oil (“downstream greenhouse gas emissions”).

Under Alternative A, approximately 52 percent of NPR-A’s subsurface would be available for oil and gas leasing. **Table 3-1** summarizes the potential peak annual production rate and corresponding production, downstream and total greenhouse gas emissions for low and high hypothetical development scenarios in all alternatives. **Table 3-2** similarly shows emissions for a 70-year lifetime. Peak annual production greenhouse gas emissions (using 100-year global warming potentials) from future development in Alternative A are 1.17 percent and 4.90 percent of the 2015 Alaska greenhouse gases total of 41 million metric tons (ADEC 2018) in the low and high scenarios, respectively. The peak annual total (sum of production and downstream) emissions represent 0.17 percent and 0.69 percent of the 2017 U.S. greenhouse gases total of 6,457 million metric tons in the low and high scenarios, respectively. These emissions also are 0.02 percent and 0.09 percent of the 2017 global greenhouse gas inventory of 50,900 million metric tons (Olivier and Peters 2018) in the low and high scenarios, respectively. On using the 20-year global warming potentials, peak annual production emissions are 1.20 percent and 5.01 percent of the Alaska greenhouse gas total in the low and high scenarios, respectively. The percentages with respect to U.S. and global totals are the same as with the 100-year global warming potentials. The lifetime greenhouse gas emissions are approximately four times higher in the high scenario than the low scenario. The greenhouse gas emissions in Alternative A will contribute to the climate change impacts described above in *Observed and Projected Climate Trends and Impacts in the Arctic and North Slope* and the global climate change impacts discussed by the Intergovernmental Panel on Climate Change (IPCC 2014).

Impacts Common to All Action Alternatives

Greenhouse gas emissions were estimated for the four IAP alternatives for two (low and high) hypothetical reasonably foreseeable development (RFD) scenarios in each alternative. A recent large representative project proposed in the NPR-A, the Willow Master Development Plan (BLM 2019), is used to estimate production greenhouse gas emissions by comparing the peak production barrels of oil per day from Willow

(131,000) and the two IAP development scenarios. Emissions from the Willow project, which includes five drill pads, gravel roads, a central processing facility, airstrip, pipeline, gravel island, and other features, are extrapolated to estimate IAP scenario emissions. The downstream greenhouse gas emissions for the two IAP development scenarios in all four alternatives were estimated using Bureau of Ocean Energy Management's Greenhouse Gas Lifecycle Model (BOEM 2019 see **Appendix G, Section G.2**). Market substitution effects that would lower the downstream emission estimates were not considered because the alternatives would be affected to a similar degree and thus the comparative differences among the alternatives would not appreciably change. Lifetime emissions from production and downstream activities were also estimated similarly using the total estimated future production over a 70-year period in the development scenarios.

The greenhouse gas emissions are calculated for carbon dioxide, methane, and nitrous oxide, as well as carbon dioxide equivalent emissions using Global Warming Potential values based on both 100-year and 20-year time horizons from the Intergovernmental Panel on Climate Change Fifth Assessment (IPCC 2014). The global warming potential accounts for the intensity of a greenhouse gas's heat trapping effect and longevity in the atmosphere; more information on the global warming potentials used are provided in **Appendix G**. Black carbon emissions were not explicitly quantified, but it is a component of particulate matter smaller than 2.5 microns and is included in the particulate matter smaller than 2.5 microns emissions discussed in **Section 3.2.2**. Details on the greenhouse gas emissions are provided in **Appendix G, Section G.3** and below for each alternative.

In addition to oil and gas development, community infrastructure projects may be permitted under all alternatives (e.g., roads, power lines, fuel pipelines/infrastructure, and communications systems) with appropriate mitigation measures. Additional greenhouse gas emissions would occur from construction and maintenance of and leaks from pipelines transporting oil and gas from offshore leases; they also would likely continue to occur from diesel-fired generators in villages, residential heating, snow machines, all-terrain vehicles, occasional aircraft, limited local vehicle traffic, and occasional open burning. In addition, helicopter and fixed-wing aircraft activities are likely to occur each summer. These and other features described in **Chapter 2, Section 2.2.1** would also potentially have climate change impacts due to greenhouse gas emissions.

Table 3-1
Peak Annual Greenhouse Gas Emissions in all Alternatives (thousands of metric tons per year)

Alternative and Scenario	Peak Production BOPD	Peak Production CO_2e (100-year GWP)	Peak Production CO_2e (20-year GWP)	Peak Down-stream CO_2e (100-year GWP)	Peak Down-stream CO_2e (20-year GWP)	Peak Total CO_2e (100-year GWP)	Peak Total CO_2e (20-year GWP)
A Low	69,000	481	492	10,215	10,245	10,696	10,737
A High	288,000	2,009	2,055	42,561	42,688	44,570	44,743
B Low	62,000	433	442	9,158	9,185	9,591	9,627
B High	259,000	1,807	1,848	38,158	38,272	39,965	40,120
C Low	87,000	607	621	12,856	12,895	13,463	13,516
C High	364,000	2,539	2,597	53,568	53,728	56,107	56,325
D Low	120,000	837	856	17,612	17,664	18,449	18,520
D High	500,000	3,487	3,566	73,381	73,601	76,868	77,167

Note: BOPD = Barrels of oil per day; CO_2e = carbon dioxide equivalent emissions; GWP = Global warming potential

Table 3-2
Lifetime Greenhouse Gas Emissions in all Alternatives (thousands of metric tons)

Alternative and Scenario	70-Year Production Total Barrels	Lifetime Production CO_2e (100-year GWP)	Lifetime Production CO_2e (20-year GWP)	Lifetime Downstream CO_2e (100-year GWP)	Lifetime Downstream CO_2e (20-year GWP)	Lifetime Total CO_2e (100-year GWP)	Lifetime Total CO_2e (20-year GWP)
A Low	367,263,075	7,020	7,179	145,780	146,215	152,794	153,390
A High	1,530,262,812	29,249	29,912	615,302	617,140	644,548	647,055
B Low	329,270,343	6,294	6,436	130,699	131,089	136,999	137,521
B High	1,371,959,763	26,223	26,817	551,650	553,298	577,875	580,118
C Low	462,244,905	8,835	9,036	183,481	184,029	192,317	193,069
C High	1,926,020,436	36,813	37,648	774,432	776,745	811,239	814,393
D Low	633,212,198	12,103	12,377	254,608	255,368	266,708	267,743
D High	2,638,384,159	50,428	51,572	1,060,866	1,064,035	1,111,277	1,115,588

Note: CO_2e = carbon dioxide equivalent emissions; GWP = Global warming potential

Alternative B

Alternative B is the most restrictive of the alternatives for the area available for oil and gas leasing. **Table 3-1** and **Table 3-2** present greenhouse gas emissions for the low and high scenarios. Peak annual production greenhouse gas emissions (using 100-year global warming potentials) from all potential future developments for the IAP are 1.06 percent and 4.41 percent of the 2015 Alaska greenhouse gas total in the low and high scenarios, respectively. The corresponding percentages with 20-year global warming potentials are only slightly different (1.08 percent and 4.51 percent). The peak annual total (production plus downstream) emissions are 0.15 percent and 0.62 percent of the 2017 U.S. greenhouse gas total in the low and high scenarios, respectively. These emissions also represent 0.02 percent and 0.08 percent of the 2017 global greenhouse gas inventory of 50,900 million metric ton in the low and high scenarios, respectively. The percentages with respect to U.S. and global totals remain approximately the same between the 100-year and 20-year global warming potentials. The lifetime greenhouse gas emissions in Alternative B (**Table 3-2**) are approximately 10 percent lower than Alternative A due to the additional restrictions on leasing, and are the lowest among all alternatives. The greenhouse gas emissions reported for Alternative B will contribute to the climate change impacts described above in *Observed and Projected Climate Trends and Impacts in the Arctic and North Slope* and the global climate change impacts discussed by the Intergovernmental Panel on Climate Change (IPCC 2014).

Alternative C

Alternative C would increase the total number of acres available for leasing compared with Alternatives A and B. This will be accomplished by reducing the areas closed to leasing in some parts of some special areas that are off limits in Alternative A. **Table 3-1** and **Table 3-2** show greenhouse gas emissions for the low and high development scenarios. Peak annual production greenhouse gas emissions from all potential future developments in the IAP calculated using 100-year global warming potentials are 1.48 percent and 6.19 percent of the 2015 Alaska greenhouse gas total in the low and high scenarios, respectively. The corresponding percentages with 20-year global warming potentials are 1.51 percent and 6.33 percent. The peak annual total emissions are 0.21 percent and 0.87 percent of the 2017 U.S. greenhouse gas total in the low and high scenarios, respectively. These emissions also are 0.03 percent and 0.11 percent of the 2017 global greenhouse gas inventory of 50,900 million metric ton in the low and high scenarios, respectively. The percentages with respect to U.S. and global totals remain approximately the same between the 100-year and 20-year global warming potentials. The lifetime greenhouse gas emissions in Alternative C (**Table 3-2**) are 26 percent higher than Alternative A. The greenhouse gas emissions due to Alternative C will contribute further to the climate change impacts described above in *Observed and Projected Climate Trends and Impacts in the Arctic and North Slope* and other global climate change impacts (IPCC 2014).

Alternative D

Alternative D is the least restrictive of the alternatives and would make the most land available for leasing and open to new infrastructure in special areas such as Teshekpuk Lake. **Table 3-1** and **Table 3-2** present greenhouse gas emissions for the low and high scenarios. Peak annual production greenhouse gas emissions from the hypothetical developments in the IAP calculated using 100-year global warming potentials are 2.04 percent and 8.50 percent of the 2015 Alaska greenhouse gas total in the low and high scenarios, respectively. The corresponding percentages calculated with 20-year global warming potentials are only slightly different (2.09 percent and 8.70 percent). The peak annual total (production plus downstream) emissions are 0.29 percent and 1.19 percent of the 2017 U.S. greenhouse gas total in the low and high scenarios, respectively. These emissions also are 0.04 percent and 0.15 percent of the 2017 global greenhouse gas inventory in the low and high scenarios, respectively. The percentages with respect to U.S. and global totals with 20-year global warming potentials are approximately the same as with 100-year global warming potentials. The lifetime greenhouse gas emissions in Alternative D are approximately 75 percent higher than Alternative A, due to the larger area available for leasing. The greenhouse gas emissions due to Alternative D will contribute further to the climate change impacts described above in *Observed and Projected Climate Trends and Impacts in the Arctic and North Slope* and the other global climate change impacts discussed by the Intergovernmental Panel on Climate Change (IPCC 2014).

Social Costs of Greenhouse Gas Emissions

The Social Cost of Carbon, a measure to assess the economic cost of an action's climate change effects, was not used in the EIS; the reasons for not using it are provided in **Appendix G, Section G.2**.

Impacts of Climate Change on Potential Development

Climate change could impact future development in the NPR-A through several ways such as thawing of the permafrost, shorter ice road or winter construction season, and changes to precipitation. Thawing of the permafrost and uneven settlement could cause damage to infrastructure such as gravel pads, roads, and pipelines. If temperatures continue to warm in the area, the warm season active zone (thawed soil zone) would go deeper, making equipment movement more difficult in warm months, possibly increasing road maintenance frequency. While thawing permafrost may in some instances make excavation easier, if summer active soil depth increases substantially, allowances would need to be made for more structural supports that rely on permafrost, perhaps requiring deeper anchoring of such supports. A shorter ice road season can affect transport of materials and personnel that depend on ice roads. More precipitation could increase surface runoff and the design of surface heights of bridges and other features should be constructed in consideration of more extreme precipitation.

Cumulative Impacts

The potential effects of greenhouse gas emissions are inherently a global cumulative effect. Due to the global effects of climate change, the cumulative greenhouse gas emissions presented in **Table 3-2** include emissions that are released outside of the North Slope via downstream emissions. Also, due to the long lifetime of carbon dioxide, carbon dioxide equivalent emissions are analyzed for a 100-year time horizon in addition to a 20-year time horizon as noted above rather than the cumulative effects period analyzed by other resources. To qualitatively assess the cumulative impact of the greenhouse gas emissions from the alternatives on climate change, it is useful to understand the magnitude of the proposed action's greenhouse gas emissions relative to local, regional, national, or sector-wide emissions (CEQ 2019). Examples of such comparisons have been presented for each alternative above. The potential cumulative climate impacts of global development and associated greenhouse gas emissions have also been summarized above in *Observed and Projected Climate Trends and Impacts in the Arctic and North Slope* and discussed extensively in the literature, including several reports by the Intergovernmental Panel on Climate Change and numerous scientific journals; hence, they are not repeated here (e.g., IPCC 2014 and references therein; Melillo et al. 2014).

3.2.2 Air Quality

Affected Environment

This section describes the attainment status (regulatory compliance with air standards), air quality classification areas (including Prevention of Significant Deterioration in Class I areas), existing emissions, and existing air quality in the NPR-A.

Attainment Status

The Alaska Ambient Air Quality Standards (AAAQS), listed in 18 Alaska Administrative Code (AAC) 50.010 for the six criteria air pollutants, are provided in **Appendix H**, **Table H-1**, and are similar to the Environmental Protection Agency's (EPA) National Ambient Air Quality Standards (NAAQS) although Alaska also has some additional standards. The NPR-A is designated as "attainment/unclassifiable" for all criteria air pollutants. The only nonattainment area (for particulate matter smaller than 2.5 microns) in Alaska is the Fairbanks North Star Borough, over 400 kilometers (km) away from the NPR-A (EPA 2019).

Air Quality Classification Areas

The Prevention of Significant Deterioration provisions of the Clean Air Act protect air quality in geographic areas designated as "attainment/unclassifiable." Prevention of Significant Deterioration provisions require that new major sources or major modifications at existing sources do not result in a violation of the NAAQS or exceed Prevention of Significant Deterioration increments relative to a baseline date (40 CFR 52.21).[1] The Prevention of Significant Deterioration program includes special protections for designated Class I areas (40 CFR 51.166) and requires Federal Land Managers to protect air quality related values, such as visibility and deposition (NPS 2011). There are no Class I areas within 300 km of the NPR-A.

Existing Emission Sources

There are a number of existing sources, both onshore and offshore, in the North Slope and adjacent waters area with emissions that affect air quality (**Appendix H, Section H.6**). Overall, onshore oil and gas sources typically comprise the largest fraction of existing emissions. The Clean Air Act also mandates that the EPA regulate 187 hazardous air pollutants that are known or suspected to cause serious health effects or adverse environmental effects (42 U.S. Code (USC) 7412). The EPA established National Emission Standards for Hazardous Air Pollutants to regulate specific categories of stationary sources that emit one or more hazardous air pollutants (40 CFR 63). The largest existing sources of hazardous air pollutants in the North

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[1] Note that Prevention of Significant Deterioration applies to individual sources only; therefore, a Prevention of Significant Deterioration increment analysis is not done in this EIS.

[2] Note that data from sites are being compared with the level of the NAAQS (i.e., the concentration) and a statistic related to the form of the NAAQS (e.g., the 98th percentile for particulate matter smaller than 2.5 microns), and not based on the complete form of the NAAQS (e.g., for 24-hour particulate matter smaller than 2.5 microns, the form of the NAAQS is a 3-year average of the 98th percentile).

Slope are onshore oil and gas, other non-road vehicles/equipment, on-road gasoline trucks, and waste incineration, combustion, and landfills.

Existing Air Quality

Air quality includes air pollutant concentrations and air quality related values, such as atmospheric deposition and visibility. Air quality related values are assessed in this EIS at three nearby federally managed areas with sensitive receptor locations, referred to hereafter in the Air Quality section as the three assessment areas: Arctic National Wildlife Refuge (ANWR), Gates of the Arctic National Park, and Noatak National Preserve (**Appendix H**, **Figure H-2**) (18 AAC 50.015). Existing meteorological conditions in the NPR-A are described in **Section 3.2.1** and **Appendix G**.

Air Pollutant Concentrations

Tables H-8 through **H-14** in **Appendix H** summarize monitored concentrations of criteria air pollutants in the form of the standard at various monitoring locations in the North Slope. There are no state or federal air quality monitoring stations in or near the NPR-A, and all the monitors shown in the tables are operated by industry for permitting purposes. The monitored concentrations are all well below the NAAQS[2] and AAAQS. Based on this limited set of monitoring data for the region, the existing air quality is not expected to pose risks to human health or the environment. This is consistent with the EPA's designation of the region as "attainment/unclassifiable" for all criteria air pollutants. Generally, air quality concentrations have been fairly stable with no discernable trends either increasing or decreasing. Sites in closer proximity to Prudhoe Bay and the more densely developed portions of the North Slope (Kuparuk, Alpine, and A-Pad monitors) tend to have higher ambient concentrations than sites closer to the NPR-A (Nuiqsut, Umiat, and Wainwright monitors). Air quality in the region is also affected by air pollution resulting from emissions from northern Europe and Asia that are transported to northern Alaska.

Hazardous Air Pollutants

Appendix H, **Table H-13** summarizes monitored concentrations of certain hazardous air pollutants (benzene, toluene, ethyl-benzene, xylenes, n-hexane, and formaldehyde) measured at the Nuiqsut monitor during 2014 through 2019. All concentrations are well below EPA' Reference Exposure Levels and Acute Exposure Guideline Levels (EPA 2018).

Air Quality Related Values

Air quality-related values include atmospheric deposition and visibility.

Visibility data are collected by Interagency Monitoring of Protected Visual Environments at monitoring sites at or near Class I areas. The two closest monitors to the NPR-A with available data are Gates of the Arctic National Park (approximately 300 km) and Denali National Park (approximately 650 km). Although these monitors are distant from the NPR-A, data are shown for informational purposes. **Figures H-6** and **H-7** in **Appendix H** show the monitored haze index, expressed as deciviews at these two locations for the 20 percent haziest and 20 percent clearest days, along with the estimated visibility under natural conditions. The haze index on the haziest days shows a clear downward trend in visibility reduction during the haziest days at both sites.

Trends in the wet deposition fluxes of ammonium, nitrate, and sulfate at the National Atmospheric Deposition Program's National Trends Network (NADP 2018) monitors in Gates of the Arctic National Park, Poker Creek, and Denali National Park are shown in **Figures H-8** through **H-10** in **Appendix H**. Most values are below 1.0 kilograms per hectacre per year with no apparent trend in most cases; however, wet deposition fluxes of ammonium at Poker Creek and Denali National Park, and nitrate at Denali National

Park have shown an upward trend in recent years. The estimated total deposition flux of nitrogen and sulfur at Denali National Park from 1999 to 2017 is provided in **Figure H-11** in **Appendix H**. The estimated total deposition flux of nitrogen at Denali in all years is well below the critical load for atmospheric nitrogen deposition (1.0–3.0 kilograms of nitrogen per hectacre per year) of the region (Sullivan 2016).

Direct and Indirect Impacts

Activities Not Associated with NPR-A Oil and Gas Exploration and Development

The planning area will likely continue to be impacted by occasional open burning as well as emissions from diesel-fired generators in villages, residential heating, snow machines, all-terrain vehicles, occasional aircraft, and limited local vehicle traffic. Air quality in the planning area could also be affected by air emissions of criteria and hazardous air pollutants due to potential coal mining, gravel mining and/or gravel transportation, and pipelines that transport offshore production to interior pipeline connections, as described in **Chapter 2**, **Section 2.2.1**.

Oil and Gas Exploration and Development Activities

Air Pollution Emission Sources

Oil and gas development and associated activities result in airborne emissions. The primary sources of these emissions include construction dust, road dust, vehicle and machinery emissions, flaring, venting of gas, burning of refuse, oil processing, and emissions from power generation.

The following air pollutants would be produced under all alternatives during activities associated with oil and gas exploration and development: nitrogen oxides; sulfur dioxide; particulate matter, including both particulate matter smaller than 2.5 microns and particulate matter smaller than 10 microns; carbon monoxide; hazardous air pollutants; and volatile organic compounds. The types and amounts of air pollutants generated vary according to the development phase.

It is anticipated that helicopter and fixed-wing activity would occur throughout the planning area under all alternatives, regardless of the phase of activity. Flights would have a transitory impact on air quality in the planning area, as well as additional flights out of Deadhorse, Prudhoe Bay, Utqiaġvik, and other airfields on the North Slope. The primary air pollutant emitted from this activity is carbon monoxide. During the exploration/ delineation phase, emissions would be produced by drilling equipment required for exploratory and delineation wells, trucks and other vehicles used to support exploration, and intermittent activities such as mud degassing and well testing. The primary emissions from these activities would be emissions of carbon monoxide, nitrogen oxides, particulate matter, and sulfur dioxide.

During the construction phase, emissions would primarily be produced by drilling engines/turbines, heavy construction equipment used to install well modules and pipelines, and ground-based support vehicles and aircraft. The principal emissions from this phase would be carbon monoxide and nitrogen oxides, with lesser amounts of particulate matter and sulfur dioxide. During the production phase, the principle sources of emissions would be power generation for heating, oil pumping, and water injection. These emissions would primarily be carbon monoxide and nitrogen oxides with lesser amounts of particulate matter. In addition, there would be minimal evaporative losses of volatile organic compounds from oil/water separators, pump and compressor seals, valves, and storage tanks. During the closure, abandonment and reclamation phase, vehicles and other emissions sources similar to the construction phase would be used. These activities would result in emissions similar to the construction phase. During the transportation phase, additional emissions occur associated with exporting the product. Intermittent emissions of nitrogen oxides, volatile organic compounds, and possibly sulfur dioxide could also occur from venting and flaring.

In addition, certain hazardous air pollutants (benzene, toluene, ethyl-benzene, xylenes, n-hexane, and formaldehyde) may be emitted due to the volatilization of oil and gas resources. Formaldehyde may also be emitted from compressor engines, and hydrogen sulfide may also be found in oil, depending on conditions (BLM 2012).

Effects of Air Pollution due to Emission Sources

The Alaska Department of Environmental Quality is responsible for regulating and permitting air quality emissions in the NPR-A, under the State Implementation Plan. Operators in this area would be required to meet Alaska Department of Environmental Quality requirements for air emissions, such as obtaining construction and operating permits. All activities by the BLM must comply with all applicable air quality laws, regulations, standards, increments, and implementation plans, whether these activities occur directly or through use authorizations.

Air quality effects could be short term (hours, days, or weeks) or long term (seasons or years), and local or regional (North Slope). Air pollutant concentrations could increase during the construction or operation phases and could result in decreased visibility or increased atmospheric deposition of pollutants. Air quality impacts from a project could be reduced by limiting the emission sources (fuel characteristics, engine specifications, etc.), spacing (such as separating concurrent drilling operations to reduce combined impacts), limiting the season and timing of operations (to enhance favorable dispersion conditions), and requiring specific control measures (road watering, low nitrogen oxides engines, flares, etc.).

Construction and operation activities can also emit fugitive dust emissions (primarily as particulate matter smaller than 10 microns). These emissions typically occur in the summer months due to driving on unpaved roads, but vehicles can also track out fine materials from gravel mining operations in both the winter and summer months. These emissions could potentially be mitigated by limiting vehicle speeds and treating problematic road sections with surfactants or water.

Emission impacts from well closure, abandonment, and reclamation activities could be reduced by leaving gravel on-site, limiting the amount of materials requiring transport. Once reclamation activities are complete, production facilities would have no further impact on air quality in the planning area (BLM, 2012).

Effectiveness of Stipulations and Required Operating Procedures

Stipulations and required operating procedures (ROP) listed in **Chapter 2**, **Table 2-2** and **Table 2-3** have the potential to influence air quality either via effective reductions to air quality impacts or through indirect impacts on air quality that result from impact reductions intended for other resources. ROPs that could potentially affect air quality are listed in **Appendix H**, **Table H-14** alongside a description of their effectiveness and possible impact. Those ROPs that are not pertinent to air quality are not listed or described in **Appendix H**, **Table H-14**.

Impacts Common to All Alternatives

The methodology used to analyze air quality impacts is discussed in detail in **Appendix H**. In summary, emissions prepared for peak production rates for a recent representative project proposed in the NPR-A, the Willow Master Development Plan project (BLM 2019), are extrapolated to estimate emissions of criteria air pollutants and hazardous air pollutants for three hypothetical RFD scenarios (low, medium, and high scenarios) under each IAP alternative.

The modeling referenced for this analysis is designed to determine whether anticipated emissions could lead to a violation of the NAAQS/AAAQS, and as such the modeling results are based on the maximum impact at the location where this maximum impact is modeled to occur using worst case meteorology. The models used for these analyses are EPA-approved regulatory models that are necessarily conservative (meaning they err on the side of overestimation), and have specific methodologies to be followed. What the modeling does not disclose is the impacts at all other locations at all other times. It can be assumed that the criteria air pollutant and hazardous air pollutant concentrations at all other areas and times in the project locations would be well below the modeled maximum concentrations, and in reality, for most locations and times would be effectively no impact due to basic meteorological constraints (i.e., which way the wind is blowing). The relative likelihood of any specific location in the project area being affected by emissions from any specific source can be generally estimated by comparison to the wind rose show in **Appendix G** (**G.1.3**).

Impacts anticipated near a potential individual development (within 50 km) in any of the alternatives are estimated by tiering to a near-field modeling analysis conducted for the Willow project. Regional (far-field) air quality impacts are evaluated for the IAP through photochemical modeling of the high development scenario in Alternative D (which has the highest hypothetical production rate across all alternatives and scenarios); far-field impacts under other alternatives are assessed qualitatively based on expected differences relative to Alternative D.

All alternatives would have potential impacts on air quality near future developments as well as on a regional scale due to the emissions sources described above. The types of emissions due to the alternatives are discussed in the *Air Pollution Emission Sources.*

The proposed Willow project includes five drill pads, a central processing facility, airstrip, gravel mine, gravel roads, pipeline, and other features; therefore, the near-field impacts from individual future developments in the NPR-A are expected to be comparable to or less than impacts from the Willow project, and the Willow EIS near-field analysis results are used as a surrogate for the near-field analysis for the NPR-A IAP. The Willow project also includes a gravel island, which is representative of a gravel island that would occur under the IAP alternatives.

The near-field impact assessment was conducted using the EPA regulatory air dispersion model AERMOD to assess criteria air pollutants (excluding ozone and lead) and hazardous air pollutants within 50 km of a development. Individual developments are anticipated to emit very little lead (apart from some lead emissions from aircraft); hence, this is not an issue of concern. Ozone impacts are assessed using the far-field modeling discussed later. Total air quality concentrations (AERMOD modeled air concentrations from an individual development plus background air concentrations from existing emissions sources) were compared with the applicable NAAQS and AAAQS (**Appendix H**, **Table H-1**). Hazardous air pollutant emissions from construction and drilling activities would be substantially lower than routine operations and thus, only hazardous air pollutant impacts for routine operations were modeled.

The near-field impact analyses were based on maximum emissions (BLM 2019). All criteria air pollutant impacts for construction, pre-drilling, development drilling, and routine operation scenarios would be below NAAQS and AAAQS. **Table 3-3** provides a summary of the maximum total criteria air pollutant impacts (modeled impacts with background concentrations added) within 50 km of the development and at a

Table 3-3
Maximum Near-field Impacts for a Representative Development in the NPR-A and Comparison to Ambient Air Quality Standards

Pollutant	Averaging Period	Construction Activity		Pre-Drill Activity		Development Drilling Activity		Routine Operations	
		Total Concentration[1] $(\mu g/m^3)$, % of AAQS		Total Concentration $(\mu g/m^3)$, % of AAQS		Total Concentration $(\mu g/m^3)$, % of AAQS		Total Concentration $(\mu g/m^3)$, % of AAQS	
		Near-field Maximum	Nearby Community [a]	Near-field Maximum	Nearby Community [a]	Near-field Maximum	Nearby Community [a]	Near-field Maximum	Nearby Community [a]
Carbon monoxide	1 hour	1892.1 (5%)	1345.7 (3%)	1953.2 (5%)	1302.6 (3%)	2737.2 (7%)	1344.8 (3%)	2737.3 (7%)	1344.3 (3%)
	8 hours	1687.1 (17%)	1312.0 (13%)	1674.3 (17%)	1297.8 (13%)	2291.8 (23%)	1307.9 (13%)	2291.8 (23%)	1307.2 (13%)
Nitrogen dioxide	1 hour	158.4 (84%)	55.3 (29%)	89.0 (47%)	24.1 (13%)	170.2 (91%)	53.5 (28%)	166.8 (89%)	49.9 (27%)
	Annual	23.6 (24%)	3.7 (4%)	11.8 (12%)	3.2 (3%)	27.2 (27%)	3.4 (3%)	26.0 (26%)	3.4 (3%)
Sulfur dioxide	1 hour	10.5 (5%)	7.7 (4%)	10.0 (5%)	6.9 (4%)	26.9 (14%)	7.4 (4%)	8.4 (4%)	7.4 (4%)
	3 hours	14.5 (1%)	9.5 (1%)	12.1 (1%)	9.1 (1%)	21.3 (2%)	9.4 (1%)	21.3 (2%)	9.4 (1%)
	24 hours	10.1 (3%)	9.0 (2%)	10.5 (3%)	8.9 (2%)	16.0 (4%)	9.0 (2%)	16.0 (4%)	9.0 (2%)
	Annual	2.5 (3%)	2.4 (3%)	2.7 (3%)	2.4 (3%)	3.8 (5%)	2.4 (3%)	3.3 (4%)	2.4 (3%)
Particulate matter smaller than 10 microns	24 hours	120.5 (80%)	21.7 (14%)	34.4 (23%)	20.5 (14%)	98.8 (66%)	32.8 (22%)	98.8 (66%)	32.7 (22%)
Particulate matter smaller than 2.5 microns	24 hours	22.5 (64%)	8.6 (24%)	17.1 (49%)	8.2 (23%)	24.4 (70%)	8.5 (24%)	24.0 (69%)	8.5 (24%)
	Annual	5.2 (44%)	2.0 (17%)	3.0 (25%)	2.0 (16%)	5.9 (49%)	2.0 (17%)	5.4 (45%)	2.0 (17%)

Note: [a] Near-field is within 50 km; the nearby community is approximately 40 km away from the source.

[1] “Total Concentration” (for all activities and operations in **Table 3-3**) is equal to source impacts plus background levels.

representative nearby community,[2] approximately 40 km away. Hazardous air pollutant emission impacts for routine operations would be below the respective Reference Exposure Level and Reference Concentrations (**Table 3-4**). The cancer risks for modeled individual hazardous air pollutants, as well as total cancer risks (for both maximum exposed individual and maximum likelihood estimate cancer risk scenarios) across all hazardous air pollutants, would be less than a one-in-one million risk at a nearby community for all carcinogenic hazardous air pollutants analyzed. (Note that for this analysis both the maximum exposed individual and maximum likelihood estimate scenarios are the same.) Emissions of individual hazardous air pollutants were estimated using relevant emission factors and activity data. Hazardous air pollutants were then modeled using the air dispersion model. A detailed description of the modeling results can be found in **Appendix H.**

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[2] The “nearby community” modeled in the Willow EIS (BLM 2019) was Nuiqsut. This is assumed to be representative of a community near an individual future development in the NPR-A.

Table 3-4
Maximum Hazardous Air Pollutant Impacts for a Representative Development in the NPR-A and Comparison to Thresholds

Pollutant	Max 1-hour within 50 km (μg/m^3)	1-hour Acute REL (μg/m^3)	Max 8-hour within 50 km (μg/m^3)	8-hour Sub-Chronic AEGLs (μg/m^3)	Max Annual within 50 km (μg/m^3)	Annual RfC (μg/m^3)	Cancer Risk at nearby community [a] (1/(μg/m^3))
Benzene	12.9	27	8.7	29000	0.3	30	1.98x10^9
Ethylbenzene	335.4	140000	224.3	140000	7.7	1000	1.47 x10^8
Formaldehyde	0.9	55	0.4	1100	0.03	9.8	7.83 x10^{10}
n-hexane	822.2	10000000	549.7	10000000	19.0	700	NA
Toluene	38.1	37000	25.5	250000	0.9	5000	NA
Xylene	660.4	22000	441.6	560000	15.3	100	NA
						Total Cancer Risk:	1.74 x10^8

Note: REL (Reference Exposure Level); AEGL (acute exposure guideline level); RfC (Reference concentrations)

[a] Nearby community is approximately 40 km away from the source.

A summary of the maximum criteria air pollutant impacts due to a gravel island is shown in **Table 3-5**, below. Total concentrations refer to AERMOD modeled air concentrations from an individual development plus background air concentrations from existing emissions sources. These data are based on modeling previously conducted for the Willow project (BLM 2019). Onshore impacts are anticipated to be below all ambient air quality standards everywhere in the near-field (within 50 km). Modeled impacts diminish rapidly with distance from the gravel island and are negligible 25 km away. Impacts for hazardous air pollutants were not directly modeled for the gravel island because hazardous air pollutants emissions (and hence impacts) from these activities would be substantially lower than the routine operations scenario in all alternatives. Emissions activities at the gravel island include generator engines and heaters, tug and barges, gravel island construction, and mobile sources; they would occur for a 5- to 10-year period and not over the entire life of the project. If a barge landing were to be used in place of a gravel island, the impacts would be less than or comparable to the impacts from a gravel island. This is because emissions associated with gravel island construction activity would not occur with a barge landing rather than a gravel island.

Table 3-5
Maximum Impacts due to Gravel Island Operations

Pollutant	Averaging Period	AAQS (μg/m^3)	Total Concentration (μg/m^3), % of AAQS
Carbon monoxide	1 hour	40,000	1,770.7 (4%)
	8 hours	10,000	1,403.5 (14%)
Nitrogen dioxide	1 hour	188	138.6 (74%)
	Annual	100	3.8 (4%)
Sulfur dioxide	1 hour	196	8.4 (4%)
	3 hours	1,300	10.1 (1%)
	24 hours	365	9.1 (2%)
	Annual	80	2.4 (3%)
Particulate matter smaller than 10 microns	24 hours	150	25.1 (17%)
Particulate matter smaller than 2.5 microns	24 hours	35	9.9 (28%)
	Annual	12	2.0 (17%)

Note: AAQS = National and/or Alaska Ambient Air Quality Standards

Alternative A

Alternative A is the current management of the IAP including all stipulations, leasing areas, and estimates of potential future development levels as was approved in the February 2013 NPR-A IAP Record of Decision (ROD).

The peak production barrels of oil per day for Willow (131,000) was used to scale and estimate emissions for all IAP alternatives under low, medium, and high development scenarios using the peak production barrels of oil per day for each IAP alternative and scenario. Details on the emissions methodology are provided in **Appendix H** (**Section H.3**). The emissions of criteria air pollutants and hazardous air pollutants in Alternative A are provided in **Table 3-6**.

Table 3-6
Annual Emissions of Criteria and Hazardous Air Pollutants due to Peak Production in each Alternative and Development Scenario (tons/year).

Alternative	Development Scenario	NOx	CO	VOC	SO_2	PM_{10}	$PM_{2.5}$	Total HAPS
A	Low	401.7	371.5	379.9	27.8	134.9	50.1	43.7
	Medium	704.4	651.5	666.3	48.7	236.5	87.9	76.7
	High	1,676.6	1,550.8	1,585.8	115.9	563	209.2	182.6
B	Low	360.9	333.8	341.4	24.9	121.2	45	39.3
	Medium	634.6	586.9	600.2	43.9	213.1	79.2	69.1
	High	1,507.8	1,394.6	1,426.1	104.2	506.3	188.1	164.2
C	Low	506.5	468.5	479	35	170.1	63.2	55.2
	Medium	890.7	823.8	842.4	61.6	299.1	111.1	97
	High	2,119.1	1,960	2,004.3	146.5	711.6	264.4	230.7
D	Low	698.6	646.1	660.7	48.3	234.6	87.2	76.1
	Medium	1,222.5	1,130.8	1,156.3	84.5	410.5	152.5	133.1
	High	2,910.8	2,692.3	2,753.1	201.2	977.4	363.2	317

Note: NOx (nitrogen oxides); CO (carbon monoxide); VOC (volatile organic compounds); SO_2 (sulfur dioxide); PM_{10} (PM smaller than 10 microns); $PM_{2.5}$ (PM smaller than 2.5 microns); HAPs (hazardous air pollutants: benzene, ethylbenzene, formaldehyde, n-hexane, toluene, and xylene)

Exploration, development, and production activities are expected to cause increases in the concentrations of criteria air pollutants and hazardous air pollutants.

Maximum near-field impacts have been described in *Impacts Common to All Alternatives* and, as discussed, criteria air pollutant impacts would be below all NAAQS and AAAQS in the near-field of an individual future development in the NPR-A. The impacts described are representative of one future development within a 50 km distance. These impacts are an overestimate of the impacts that would occur under low and medium development scenarios because the total RFD production across the NPR-A in Alternative A under either of these two scenarios (69,000 and 121,000 barrels of oil per day) is less than the production from just the Willow project (131,000 barrels of oil per day).

Regional air quality impacts due to oil and gas development across the NPR-A in Alternative A are expected to be less than alternatives C and D in the IAP due to less federally owned subsurface being available for leasing, and higher than Alternative B due to more federally owned subsurface available for leasing. Quantitative modeled impacts for Alternative D are presented below.

Alternative B

Exploration, development, and production activities in Alternative B would cause increases in the concentrations of criteria air pollutants and hazardous air pollutants. Alternative B is similar to Alternative A but would provide more specific guidance pertaining to non-oil and gas related activities. Also, the area unavailable for leasing (and closed to new infrastructure) would be increased from Alternative A. Emissions of criteria air pollutants and hazardous air pollutants under Alternative B (**Table 3-6**) are approximately 10 percent lower than those in Alternative A.

Typical near-field impacts have been described in *Impacts Common to All Alternatives* and, as discussed, there would be no exceedances of NAAQS or hazardous air pollutant thresholds. The impacts described are representative of one future development within a 50 km distance. These impacts are an overestimation of the impacts that would occur under low and medium development scenarios, as no central processing facility would be developed under these scenarios.

Likely near-field impacts at Nuiqsut, Atqasuk, and Utqiaġvik were compared across alternatives by examining a spatial map of the amount of land surrounding each community that is open or closed to fluid mineral leasing in Alternative B. The opportunity for leasing near Atqasuk, Nuiqsut, and Utqiaġvik is lower in Alternative B compared with Alternatives A, C, and D, as more land near Nuiqsut is subject to no surface occupancy (NSO) or closed to fluid mineral leasing, and the land near Atqasuk and Utqiaġvik is closed to fluid mineral leasing. Therefore, if development were to occur near these communities, impacts on the communities in Alternative B are expected to be the lowest compared with the other alternatives.

Far-field (regional) impacts from Alternative B are expected to be the lowest compared with the other alternatives due to substantially less federally owned subsurface being available for oil and gas leasing compared to Alternatives C and D, and slightly less compared with Alternative A. As a result, air pollution would be correspondingly reduced compared to the other alternatives. Quantitative modeled impacts for Alternative D are presented in below.

Alternative C

Alternative C would increase the total number of acres available for leasing compared to Alternatives A and B. Emissions of criteria air pollutants and hazardous air pollutants under Alternative C can be seen in **Table 3-6**. These are approximately 26 percent higher than those in Alternative A.

Typical near-field impacts have been described in *Impacts Common to All Alternatives* and, as discussed, there would be no exceedances of NAAQS or hazardous air pollutant thresholds. The impacts described are representative of one future development within a 50 km distance. These impacts are an overestimation of the impacts that would occur under the low development scenario. This is because under the low development scenario total IAP production across the NPR-A is lower than the production from the hypothetical project (i.e., the low development scenario would have 87,000 barrels of oil per day versus the hypothetical project emissions for 131,000 barrels of oil per day). As such, emissions and thus impacts would likely be lower under the low development scenario than the near-field impacts described below.

Likely near-field impacts at Atqasuk, Nuiqsut, and Utqiaġvik were compared across alternatives by assessing the amount of land surrounding each community that is open or closed to fluid mineral leasing in Alternative C (see **Map 2-3** in **Appendix A**, Maps). The opportunity for leasing near Nuiqsut is comparable between Alternatives A, C and D whereas more land near Nuiqsut is closed to leasing in Alternative B. Therefore, if a development were to occur near Nuiqsut, impacts on the community of Nuiqsut under Alternative C are expected to be comparable to Alternative A and D and higher than Alternative B. An examination of the land near Atqasuk and Utqiaġvik that is available for leasing and subject to NSO shows that impacts on those two villages in Alternative C are expected to be lower than in Alternatives A and D and higher than Alternative B.

Exploration, development, and production activities are expected to cause increases in the concentrations of criteria air pollutants and hazardous air pollutants. Regional air quality impacts from Alternative C are expected to be higher than alternatives A and B due to more federally owned subsurface being available for oil and gas leasing, and lower than Alternative D due to substantially less federally owned subsurface being available for leasing. As a result, regional air pollution would be correspondingly increased compared to alternatives A and B, and decreased compared to Alternative D. Quantitative modeled impacts for Alternative D are presented in below.

Alternative D

Alternative D would make the most land available for leasing and open to new infrastructure. Emissions of criteria air pollutants and hazardous air pollutants under Alternative D are provided in **Table 3-6** and are approximately 74 percent higher than in Alternative A.

Typical near-field impacts have been described in *Impacts Common to All Alternatives* and, as discussed, there would be no exceedances of NAAQS or hazardous air pollutant thresholds at nearby communities in Alternative D. The impacts described are representative of one future development (comparable to Willow) within a 50 km distance for the medium and high development scenarios and are an overestimate of the impacts under the low scenario. This is because under the low development scenario total IAP production across the NPR-A is lower than the production from the hypothetical project (i.e., the low development scenario would have 120,000 barrels of oil per day versus the hypothetical project emissions for 131,000 barrels of oil per day). As such, emissions and thus impacts would likely be lower under the low development scenario than the near-field impacts described below.

The likelihood for near-field impacts at Nuiqsut, Atqasuk and Utqiaġvik was compared across alternatives by assessing the amount of land surrounding each community that is open or closed to fluid mineral leasing in Alternative D. The opportunity for leasing near Nuiqsut is comparable between Alternatives A, C and D whereas more land near Nuiqsut is closed to leasing in Alternative B. Therefore, if development were to occur near Nuiqsut, impacts on the community of Nuiqsut under Alternative D are expected to be comparable to Alternatives A and C and higher than Alternative B. An examination of the land near Atqasuk that is available for leasing and subject to NSO shows that impacts on Atqasuk in Alternative D are expected to be lower than in Alternative A (due to higher likelihood of a development near Atqasuk in Alternative A than D due to more land available for fluid mineral leasing in the former) and higher than Alternatives B and C. There is more land near Utqiaġvik that is open to leasing, subject to NSO indicating that impacts on Utqiaġvik in Alternative D would likely be higher than Alternatives A, B, and C.

The far-field (regional) impact assessment for the high development scenario in Alternative D was conducted using the Comprehensive Air Quality Model with Extensions. The high development scenario in Alternative D has the highest production rate across all alternatives and development scenarios; thus, regional impacts are expected to be higher than other alternatives and development scenarios. Air concentrations of carbon monoxide, ozone, particulate matter smaller than 2.5 microns, particulate matter smaller than 10 microns, nitrogen dioxide, and sulfur dioxide, are estimated as well as nitrogen and sulfur atmospheric deposition and visibility impairment. Air quality impacts are calculated over the region shown in **Appendix H**, **Figure H-2**, and are compared with NAAQS, AAAQS, and air quality related values. Impacts are assessed for: (1) IAP development impacts, and (2) cumulative impacts that also include all other sources modeled in the Willow EIS (BLM 2019). The IAP development impacts were obtained by difference between the Alternative D modeling and the Willow EIS modeling. Cumulative impacts were derived from the total concentrations estimated in the Alternative D modeling, which included other regional sources and background concentrations. **Appendix H** details the modeling approach.

Cumulative Alternative D impacts for air concentrations were compared with the NAAQS and AAAQS standards for criteria pollutants and were found to be lower than the standards for all pollutants and averaging periods (Table 3-7) everywhere in the modeling domain, including at the villages of Atqasuk, Nuiqsut, and Utqiaġvik, and at ANWR, Gates of the Arctic National Park, and Noatak National Preserve. Air concentrations due to Alternative D development, which provides for the most development and thus emissions among the alternatives analyzed, are considerably lower than the NAAQS and AAAQS; actual impacts may vary with proximity to analyzed areas and project design. Project-specific impacts will be analyzed as part of subsequent NEPA analyses.

The cumulative nitrogen deposition impacts were lower than or within the critical load range of 1.0–3.0 kilograms per hectacre per year (Sullivan 2016) at the three conservation system units. Cumulative visibility impairment was also examined. **Table H-25** in **Appendix H** shows the cumulative visibility estimated for the Alternative D high scenario at each of the three conservation system units. For both the 20 percent best and the 20 percent most impaired days, the cumulative visibility will slightly degrade from current values at all assessment areas.

Table 3-7
Comparison of Total Concentrations in Alternative D with Air Quality Standards

Location	Carbon Monoxide		Nitrogen dioxide		Ozone	PM smaller than 2.5 microns		PM than 10 microns	Sulfur dioxide			
	8-hour	1 hour	1 hour	Annual	8 hour	Annual	24 hour	24-hour	1-hour	3-hour	24-hour	Annual
	mg/m^3	mg/m^3	μg/m^3	μg/m^3	ppb	μg/m^3	μg/m^3	μg/m^3	μg/m^3	μg/m^3	μg/m^3	μg/m^3
AAQS	**10**	**40**	**188**	**100**	**70**	**12**	**35**	**150**	**196**	**1300**	**365**	**80**
Modeled Concentrations												
Full Domain	3.4	1.0	136.1	41.6	55.5	10.1	31.4	121.3	151.8	149.2	90.2	24.4
Nuiqsut	0.2	0.2	33.8	5.0	35.8	2.0	5.5	10.8	2.5	2.3	1.3	0.3
Atqasuk	0.2	0.2	12.8	0.9	37.1	1.7	4.1	9.8	0.6	0.7	0.6	0.1
Utqiaġvik	0.2	0.2	22.6	3.7	39.5	3.6	12.4	85.8	2.8	2.9	1.2	0.4
ANWR[b]	0.7	0.5	39.5	2.9	55.5	2.5	7.3	30.5	1.9	5.4	1.8	0.3
GAAR[c]	0.2	0.2	2.3	0.4	53.4	1.4	3.9	9.9	1.8	2.3	1.5	0.2
NOAT[d]	3.4	1.0	24.4	0.9	46.8	2.6	8.8	105.6	8.3	26.2	6.2	0.2

μg/m3: micrograms per cubic meter
ppb: parts per billion

Cumulative Impacts

The far-field (regional) modeling with the Comprehensive Air Quality Model with Extensions accounts for all regional emissions and background concentrations as well as emissions from the IAP RFD development. Therefore, air concentrations and air quality related values estimated from the far-field modeling constitute the cumulative air impacts. Impacts were discussed in Alternative D and are below relevant standards. The cumulative air impacts presented in **Table 3-7** are likely peak impacts from multiple developments occurring concurrently, and air quality impacts would likely be lower during most of the cumulative effects period (see **Appendix F**, **Section F.3.1** for a description of the geographic and temporal scope of the cumulative effects assessment) from 1970 through 70 years after the ROD is signed.

The effect of climate change on the air quality resource is discussed below. Climate change is expected to continue to affect the environment in the NPR-A. The global warming trend of the past 50 years has been amplified in the Arctic. Positive feedback loops resulting from reduced overall surface reflectivity in the summer have increased the heat retention capacity of the Arctic system, which enables more melting (BLM 2014). The increased melting of snow and ice cover leads to increased thawing of permafrost and earlier greening of the tundra (Osborne et al. 2018). Thawing permafrost releases carbon into the atmosphere in the forms of carbon dioxide and methane, whereas increased vegetation growth pulls carbon dioxide out of the atmosphere. Overall, tundra in the Arctic is releasing net carbon into the atmosphere (Osborne et al. 2018).

While **Section 3.2.1** describes how activities associated with the NRP-A IAP have the potential to directly affect climate change with the emissions of greenhouse gases, alterations to Arctic climate could potentially affect other resources. The potential effects of climate change on resources other than air quality are described in the relevant resource sections. For the air quality resource, climate change has been shown to affect ground-level ozone. It has been found that concentrations of ground level ozone are likely to increase due to increasing temperatures (Wise 2009). Altered precipitation patterns could lead to increased periods of drought which has the secondary consequence of potentially increasing wildfires which would contribute to increased emissions of air pollutants. The potential for wildfires could also increase with increasing temperatures due to climate change. In addition, the increasing temperatures in the Arctic lead to a shorter period of snow cover causing the periods susceptible to wildfire and windblown dust to be longer. The effects of climate change described under the *Affected Environment*, above, are part of the baseline conditions for air quality in the project area. See **Section 3.2.1** for a detailed discussion of the alternatives' contributions to global climate change.

3.2.3 Acoustic Environment

Affected Environment

The acoustic environment, or soundscape, is the combination of all sounds in a given area. These include natural sounds, such as wind, water, and sounds caused by insects, birds, and other wildlife, as well as human-caused sounds. Human-caused sounds are considered noise because they have the potential to affect the natural acoustical environment and the noise-sensitive resources in that environment. **Table 3-8** provides examples of noise levels and human responses for context of how post-lease development activities may be perceived by human receptors.

As noted in **Table 3-8**, sound levels of 80 to 90 A-weighted decibels typically elicit annoyance. Annoyance describes a reaction to sound based on its physical nature as well as its emotional effect. Though subjective, annoyance is routinely used as a basis of evaluating environmental noise effects. The level of annoyance is affected by the persistence of the sound, whether it is impulsive versus steady, the frequency and magnitude of its fluctuation, and whether the receiver finds the sound to be pleasant or unpleasant. In general, annoyance increases with the persistence of the sound, its impulsivity, more frequent and greater fluctuations, and the perceived inability to exert control over the noise source.

Similarly, the degree to which noise may disturb wildlife receptors depends on many factors. Wildlife responses to noise are known to vary by species, by acoustical factors (e.g., frequency, intensity, and duration of noise), and by non-acoustical factors (e.g., life-history stage, environmental or behavioral context, and degree of past exposure; Francis and Barber 2013). Noise that is abrupt and unpredictable may be perceived as a threat, potentially triggering a startle response or antipredator behavior (Frid and Dill 2002; Francis and Barber 2013). Chronic noise may affect sensory capabilities via masking of biologically important natural sounds, such as those used for communication or detection of predators or prey (Francis and Barber 2013).

Table 3-8
Typical Noise Levels with Associated Human Perception or Response

Noise Source	Noise Level (A-weighted decibels)	Human Perception or Response
Air raid siren	140	Painfully loud
Thunderclap	130	Painfully loud
Jet takeoff (200 feet)	120	Maximum vocal effort
Pile driver; rock concert	110	Extremely loud
Firecrackers	100	Very loud
Heavy truck (50 feet)	90	Very annoying
Hair dryer	80	Annoying
Noisy restaurant, Freeway traffic	70	Telephone use difficult
Conversational speech	60	Intrusive
Light auto traffic (100 feet)	50	Quiet
Living room; Bedroom	40	Quiet
Library; Soft whisper (15 feet)	30	Very quiet
Broadcasting studio	20	Extremely quiet

Source: Olivera et al. 2011

Potential noise-sensitive receptors were identified through internal and external scoping and include the following:

- Residents of the communities of Nuiqsut and Utqiaġvik. Residents of Nuiqsut would be sensitive to increased noise from non-oil and gas-related activities as well as post-lease oil and gas development that occurred near the community. Residents of Utqiaġvik would be sensitive to increased noise from potential new barge landing operations. Residents of Nuiqsut have specifically expressed concerns over “humming from the infrastructure and facilities [heard from a distance of] 2 to 3 miles” and from flaring, where residents report “you can see a big flame and hear it too if the wind is right and it is coming this way” (SRB&A Unpublished-b).
- Subsistence users in the Nuiqsut and Utqiaġvik subsistence use areas, particularly when hunting, fishing, and gathering subsistence resources. Subsistence users of the Utqiaġvik subsistence use area, for instance, have reported impacts from existing seismic operations, where noise “has scared and run the game off in one direction from that area already and numerous trips made by at least half a dozen hunters have attested that, that they’ve gone from the east side of the Ikpikpuk and Chipp River to the west side” and that subsistence hunters “have purchased gasoline and planned their trips just to find out that the seismic [has affected] areas of normal hunting and the game is not there” (BLM 1997a).
- Recreation users of the Colville River area and Teshekpuk Lake

- Species that are particularly susceptible to noise disturbance, including bowhead whales, especially during fall migration; polar bears, especially during denning; caribou, especially during calving and post-calving activities; seals, especially during pupping in the winter and early spring, molting in early summer, and resting throughout the year; and migratory birds, especially during breeding and brood-rearing activities. Increased use of marine, nearshore, and coastal areas for non-oil and gas-related activities as well as post-lease development activities would have the potential to increase noise levels in areas used by these species. Residents of Nuiqsut, for instance, have described impacts from the use of air boats, explaining that "every time they go do their surveys, or checking their Conexes, they disrupt anything that is there and us too. And the caribous will take off, or the seals will pop down; anything that is near that [noise], they take off" (SRB&A 2010a).

These receptors were identified based on their potential to be affected by post-lease development activities, including oil and gas exploration, development, production, and abandonment/reclamation in the high potential areas of northeastern and eastern of the NPR-A (see **Figure B-1** in **Appendix B**), barge landing and seawater treatment facility development in northeastern coastal areas of the NPR-A, and vessel operations along the marine transit routes. These receptors would also have the potential to be affected by BLM-authorized non-oil and gas-related activities, such as infrastructure development and scientific activities.

While the IAP applies to the entire NPR-A, post-lease activities are not anticipated to affect sensitive receptors in other areas of the NPR-A. Residents, subsistence users, and recreation users in other areas of the NPR-A may experience noise increases from non-oil and gas-related BLM-authorized activities, such as infrastructure development and scientific activities.

Current Conditions

Terrestrial Acoustic Environment

The NPR-A is largely undeveloped, with oil and gas-related development concentrated in the northeastern portion of the NPR-A. Existing human-caused noise sources include the following:

- Vehicle operations (vehicles, off-road vehicles, and snowmobiles) and community noise (generators and other small equipment motors) in Atqasuk, Nuiqsut, Utqiaġvik, and Wainwright
- Vehicle, equipment, and aircraft operations associated with oil and gas production facilities in and adjacent to the northeastern portion of the NPR-A
- Vehicles, off-road vehicles, and snowmobiles used for subsistence activities and travel among villages and between villages and subsistence camps throughout the NPR-A
- Firearms used to support subsistence activities throughout the NPR-A
- Blasting to facilitate mining of gravel deposits in the northeastern portion of the NPR-A
- Motorized vessel operations
- Aircraft operations at Atqasuk, Nuiqsut, Utqiaġvik, and Wainwright airports and aircraft operations associated with non-industry-related uses such as research and recreation

Internal scoping for the EIS indicated that blasting and aircraft were the most significant sources of noise in the plan area. Disturbance of subsistence resources (particularly caribou) and subsistence activities by low-flying aircraft, including helicopters, has been an issue of concern to North Slope residents. The level of concern has increased over time as use of aircraft to support research and monitoring, recreation, oil and gas development, and other activities on the North Slope has increased during the past few decades (USFWS

BLM 2018). As reported in Stinchcomb 2017, sound levels perceived as unwanted or annoying by humans correspond with the range of sound levels emitted by low-flying aircraft, and aircraft sound is concentrated at low frequencies, which lose little energy over long distances and produce vibrations that elicit feelings of discomfort and annoyance.

A comprehensive noise survey of the NPR-A has not been undertaken. However, ambient sound levels around Nuiqsut and the lower Colville River (in the eastern portion of the NPR-A) were measured from June through August 2016, a period of peak subsistence use, to quantify natural ambient sound and aircraft noise levels. Natural ambient sound levels ranged from 25 to 47 A-weighted decibels, with a median level of 35 A-weighted decibels. The median sound exposure level of aircraft ranged from 55 to 69 A-weighted decibels (Stinchcomb 2017).

The BLM has tracked BLM staff and permitted activities that involve takeoffs since 2008 (overflights that do not take off or land in the NPR-A are not required to be reported to the BLM, nor are flight paths, elevations, or airspeed tracked). **Table 3-9** shows the number of takeoffs and lands in the NPR-A by category from 2008 to 2016.

Table 3-9
NPR-A Aircraft Takeoff and Landings (2008-2016)

User Category	2008	2009	2010	2011	2012	2013	2015	2016
Federal Government	3,655	998	3,822	1,194	2,003	1,786	1,508	1,424
State Government	0	0	55	324	374	172	523	384
North Slope Borough Dept. of Wildlife Management	75	6	0	80	291	284	302	137
Nongovernmental Research	80	114	28	150	33	20	88	7
Industry	73	540	71	503	1,405	1,295	2,258	1,819
Recreation	0	0	0	0	0	10	0	14
Total	**3,883**	**1,658**	**3,976**	**2,251**	**4,106**	**3,567**	**4,679**	**3,785**

Source: Nigro 2019

Notes: Numbers reported are from BLM staff and permitted activities; 2014 data not reported due to issues with the automated data collection system.

Federal Government—BLM monitoring/compliance and USFWS, USGS, and BOEM monitoring/research; State Government—ADFG, ADEC, and Alaska Department of Natural Resources monitoring/research; North Slope Bureau DWM—monitoring/research; Nongovernmental Research—research affiliated with universities or NSF grantees; Industry—Oil and gas exploration/development activities from multiple different companies, other infrastructure development such as cell tower construction, power and communication line proposals, proposed new roads, and other activities; Recreation – drop off and pick up support.

Marine Acoustic Environment

The underwater acoustic environment is important to marine mammals since they use noise to navigate, find prey, communicate, and detect disturbances or threats. While cetaceans typically rely on underwater acoustics, pinnipeds and polar bears perceive noises in and out of the water, such as when individuals are hauled out, spy-hopping, or traveling across the sea ice as is the case with polar bears (BOEM 2018). In the Beaufort Sea, natural sources of marine sound include wind stirring the surface of the ocean, storms, ice movements, and animal vocalizations and noises (including whale calls and echolocation clicks). The frequency and magnitude of noise from each of these producers can differ dramatically, as a result of variation in the seasonal presence of the sound sources. Existing human sources of sound in the Beaufort Sea include vessels (such as motorboats used for subsistence and local transportation, commercial shipping, and research vessels); navigation and scientific research equipment (such as benthic trawls); airplanes and helicopters; human settlements; military activities; and offshore industrial activities. No long-term underwater acoustic monitoring has been undertaken in the project area.

Climate Change

Northern environments, including the NPR-A analysis area, have experienced warming over the last half-century (SNAP 2019). This trend is expected to continue as climate models predict that high northern latitude regions will experience the greatest warming temperatures of the globe (IPCC 2014). Trends that are reflected in climate change modeling were conducted for the planning area by the Scenarios Network for Alaska Planning (SNAP) group at the University of Alaska Fairbanks (SNAP 2019).

Sound propagation in the Arctic differs from nonpolar regions. Arctic temperature inversions enhance sound propagation, and Arctic waters exhibit a very different sound-speed profile than in nonpolar regions, which is caused by a layer of freshwater near the surface or by layers with different temperatures. As a result, sound waves tend to get trapped within a certain layer of the water column (100 to 300 meters) and propagate farther than if they were not trapped in this channel (Au and Hastings 2008, cited in PAME 2019). In general, meteorological conditions tend to enhance sound levels to a lesser degree, such as 1 to 5 decibels, than decrease sound levels, such as 5 to 20 decibels (Attenborough 2014 in BLM 2018a). Ice degradation and related changes in sound-attenuating conditions are anticipated within the analysis area. The Arctic Coastal Plain Province, dominated by features and processes driven by permafrost, has the potential to change greatly with the anticipated degradation and thaw of permafrost. Through this process, climate change could affect Arctic sound propagation due to thawing permafrost and increases in water or swampy conditions that allow sound to propagate differently across the landscape.

Direct and Indirect Impacts

The methodology used to assess potential direct and indirect noise impacts is described in **Appendix F**. This analysis assumes that future IAP development would be focused in the high potential area and that little to no change in the existing acoustic environment would occur in the rest of the NPR-A, with the possible exception of increases in noise from aircraft overflights. Issuance of oil and gas leases would have no direct impacts on the environment because by itself a lease does not authorize any oil and gas post-lease activities. Therefore, the analysis is of potential direct and indirect impacts on the acoustic environment from post-lease activities. While noise impacts associated with post-lease activities are most likely to occur near and be concentrated in the high potential area, impacts from noise may occur throughout the planning area, including areas open to leasing as well as areas where non-oil and gas-related activities, such as infrastructure development and scientific activities, would occur.

Noise levels generally associated with oil and gas-related equipment and activities that would be used during exploration, development, production, and abandonment/reclamation are provided in **Table 3-10**, below. The maximum distances from a source required to attenuate to median background levels, assumed to be 35 A-weighted decibels in undeveloped portions of the NPR-A and 50 A-weighted decibels for more developed areas such as potential barge landing locations, is also provided. Longer attenuation distances are the least accurate due to considerable variations in meteorological conditions, topography, and other factors over these distances; therefore, attenuation distances over 100 miles are indicated as greater than (>) 100 miles.

Noise sources associated with both post-lease oil and gas development and non-oil and gas-related activities may be impulsive or non-impulsive. Sound levels generated by impulsive noise, such as pile driving or blasting, may significantly exceed the ambient sound level for a very short duration. Non-impulsive, more continuous noise sources, such as well production, typically emit lower levels of noise and are less likely to be audible at a distance. Multiple individual noise sources can combine to result in higher noise levels, but the combined noise is not additive. Combined noise sources that differ more than 10 A-weighted decibels from one another are dominated by the louder source.

Table 3-10
Summary of Noise Levels for Project Activities and Equipment

Noise Source	Phase	Estimated Sound 1,000 Feet from the Source A-weighted decibels [a] [Human Perception or Response][b]	Distance to 50 A-weighted decibels [Quiet] (miles)[c]	Distance to 35 A-weighted decibels [Very Quiet] (miles)[c]	Source[d]
General construction activity (multiple equipment)	E, D, AR	62 [Intrusive]	0.75	4.0	BLM 2018a
General vehicle traffic	E, P, AR	49–55 [Quiet]	0.9–0.3	0.2–1.4	BLM 2018a
Gravel truck traffic	D, AR	67–76 [Intrusive]	7.5–3.8	1.3–21.2	USACE 2018
Impact pile driving (Lmax)[e]	D	84 [Annoying]	9.5	53.3	USACE 2018
Drill rig	E, D	60.2–70.2 [Intrusive]	0.6–1.9	3.5–11	USACE 2018
Gravel mining	D	62 [Intrusive]	0.75	4.0	BLM 2018a
Gravel blasting (Lmax)[e]	D	99 [Very Annoying]	53	>100	USACE 2018
Helicopters	D, P	70–80 [Annoying]	1.9–6	10.5–33.2	BLM 2004
Fixed-wing aircraft	D, P	69–81 [Intrusive; Annoying]	1.7–6.7	6.1–20.3	BLM 2004
Tugboats, marine vessels, barges	D, P	40 [Quiet]	0	0.3	BLM 2018a
Central processing facility (Lmax)	P	52 [Quiet]	0.2	1.3	BLM 2018a
Flaring at central processing facility	P	71 [Intrusive; Annoying]	2.1	11.8	USACE 2018

Note: A-weighted decibels; mi (miles); Lmax (short-term, maximum sound level); E (exploration); D (development); P (production); AR (abandonment/reclamation)

[a] Unmitigated sound level

[b] See **Table 3-8** for human perception or response to noise levels

[c] 50 A-weighted decibels represents the ambient sound level of developed portions of the analysis area, while 35 A-weighted decibels represents the ambient sound level of undeveloped areas (natural ambient sound level)

[d] Sound levels in original sources converted to sound level at 1,000 feet

[e] Impulse noise sources; these are noise sources of short persistence, abrupt onset, and rapid attenuation. For pile driving, the noise occurs in a succession of distinct pulses.

Impacts Common to All Alternatives

Noise impacts related to pre-lease and post-lease development activities and associated seismic testing, construction, and marine vessel and aircraft traffic would occur under all of the alternatives. The degree of impact and the sensitive receptors that could be affected would depend on the location of the proposed future development activities; future proposals would be evaluated in site-specific NEPA analyses at the time of project proposal. Under all alternatives, noise impacts are expected to be generally limited to the high potential areas as shown on **Map B-1** in **Appendix B**. However, in addition to the high potential area, the NPR-A contains a number of subsistence use areas throughout the planning area that would be susceptible to noise impacts under all alternatives. These subsistence use areas include areas open to leasing as well as areas where BLM-authorized non-oil and gas activities, such as infrastructure development and scientific activities, would occur.

The effects of climate change described under the *Affected Environment*, above, are part of the baseline conditions for acoustics in the project area. See **Section 3.2.1** for a detailed discussion of the alternatives' contributions to global climate change.

Noise from Onshore Activities

Sources of noise associated with fluid mineral development are construction, operation, and support activities for oil and gas development and production. Noise during exploration would occur from seismic surveys and exploratory activities such as constructing ice roads and ice pads and performing exploratory drilling. Noise associated with these activities would be similar to those described for development, below, but would occur at a smaller scale.

During development, noise would occur from the construction of roads, well pads, central processing facilities, and airstrips; barge landings and a seawater treatment plant on the shoreline; and pipelines necessary for owners of offshore state and federal leases to bring oil and gas across the NPR-A to the Trans-Alaska Pipeline System (TAPS). General construction noise is expected to be in the range of 62 A-weighted decibels, attenuating to 50 A-weighted decibels at 0.75 miles from the construction activity and to 35 A-weighted decibels at 4 miles. The greatest source of non-impulsive constructed-related noise would be gravel haul traffic, which would have noise levels of 67–76 A-weighted decibels and would attenuate to attenuating to 50 A-weighted decibels at between 3.8 and 7.5 miles and to 35 A-weighted decibels between 7.5 and 21.2 miles.

Blasting would produce the highest discrete noise level during development but would occur only very occasionally; blasting would produce sound levels of 90 A-weighted decibels at 1,000 feet from the source. Impact equipment required for installing pipeline and bridge supports would produce pulsed sound that significantly exceeds the background sound pressure level (84 A-weighted decibels at 1,000 feet). Impact pile driving would produce substantial levels of impulsive noise but for relatively short periods (days or weeks). Because sound levels associated with blasting and pile driving are higher than other noise-producing activities, they could reach a larger area and be more disturbing than steady equipment noise and would be the dominant noise when they occur.

Noise levels of drill rigs, which would occur at a smaller scale during exploration and at a greater scale during development, is estimated to be 60.2–70.2 A-weighted decibels at 1,000 feet, attenuating to 50 A-weighted decibels between 0.6 and 1.9 miles and to 35 A-weighted decibels between 3.5 and 11 miles. Upon completion of initial wells, and with commencement of year-round operations, the primary noise sources would be located at central processing facilities and would consist of equipment used during water injection processes, oil and gas processing, and electrical power generation. The estimated source noise level of this equipment is 52 A-weighted decibels, attenuating to 50 A-weighted decibels at 0.2 miles and to 35 A-weighted decibels at 1.3 miles. Flaring, if used, could be an intermittent but long-term noise source, producing a noise level of 71 A-weighted decibels, attenuating to 50 A-weighted decibels at 2.1 miles and to 35 A-weighted decibels at 11.8 miles.

The development of coastal infrastructure would contribute to long-term, localized noise impacts in the marine environment under all alternatives, with impacts on birds and marine mammals. Noise would occur near essential coastal infrastructure and facilities necessary for oil and gas production. Specific behavioral changes in wildlife from oil and gas development-related noise are discussed in **Section 3.3**.

Noise from abandonment and reclamation activities would be at levels comparable to general construction activities. There would be short-term, temporary noises associated with this phase of fluid mineral development.

Noise from Marine Vessel Traffic

Marine vessel traffic would extend noise impacts from the barge landing areas into the marine environment along the entire 1,600-nautical-mile marine barge route, with underwater-radiated noise effects occurring from commercial ships. In-air noise levels associated with marine vessels are in the range of 40 A-weighted decibels at 1,000 feet from the vessel, 60 A-weighted decibels at 100 feet, or 80 A-weighted decibels at 10 feet (for considering noise impacts on terrestrial marine mammals and birds). These impacts would be intermittent and short term. Specific behavioral changes in wildlife from marine vessel traffic are discussed in **Section 3.3**.

Noise from Aircraft

Noise impacts from air traffic would be influenced by the number and location of future oil and gas developments. Over the shorter term and based on current permitting practices, future developments would require three years of biological surveys prior to development and then surveys in June to look for caribou and birds before ice road construction can begin. These surveys are typically performed using helicopters, which produce noise levels of 70–80 A-weighted decibels at 1,000 feet, attenuating to 50 A-weighted decibels between 1.9 and 6 miles and to 35 A-weighted decibels between 10.6 and 33.6 miles.

Over the longer term and on a more regular basis, aircraft activity would increase as oil and gas facilities with airstrips are developed, typically located at central processing facilities. Current practice on the North Slope generally includes daily flights on larger aircraft from Anchorage and Fairbanks to the Ugnu-Kuparuk airport (a privately owned airport between Nuiqsut and Prudhoe Bay, east of the NPR-A), flights on smaller aircraft from Kuparuk to the main development facility, and helicopter flights from the main development facility to the satellite pads, which do not have airstrips (Rice and Nigro 2019a). Noise produced by helicopters is described above; noise levels produced by aircraft range from 69–81 A-weighted decibels at 1,000 feet, attenuating to 50 A-weighted decibels between 1.3 and 6.7 miles and to 35 A-weighted decibels between 9.5 and 37.8 miles. The noise reduction estimates tabulated as part of the Greater Mooses Tooth Two (GMT2) Final SEIS analysis (BLM 2018a, Table 4.1-45) suggest that air traffic could be discernable 5 to 10 miles from the source for the loudest aircraft routinely operating in the region (based on a background noise level of 35 decibels). This pattern is expected to continue under the IAP. Because flights related to North Slope oil and gas industrial activity generally would not route through public airports, none of the IAP alternatives would result in increased direct noise impacts associated with operations at the Atqasuk, Nuiqsut, Utqiaġvik, and Wainwright airports. However, increased overflights are likely to occur over the eastern portion of the NPR-A under all alternatives to access post-lease developments. Flights may increase over all areas of the NPR-A related to non-lease-related BLM-authorized activities, such as scientific activities and infrastructure development.

Potential noise impacts on sensitive receptors, summarized in **Table 3-11**, would occur under all action alternatives. The degree of impact resulting from noise generated in the analysis area would vary by alternative due to differences in the areas available and unavailable to oil and gas leasing, as described under each alternative. Noise impacts on specific species and subsistence users are described in more detail in those respective resource sections.

Noise Impacts from Non-Oil and Gas-Related Activities

Potential noise impacts from construction of community infrastructure, seismic surveys of unleased areas, and pipelines transporting oil and gas from offshore leases, as well as from non-oil and gas-related activities (e.g., construction of community infrastructure and scientific activities), would be similar in nature to those described above. Such activities would produce noise not directly associated with NPR-A oil and gas exploration and development and include the use of diesel-fired generators in small villages and the use of motorized equipment, such as snowmachines, all-terrain vehicles, occasional small aircraft, and limited local vehicle traffic. The planning area could also be affected by noise associated with potential gravel mining and gravel transportation, as described in **Chapter 2**, **Section 2.2.1.** Such activities would result in noise effects at levels comparable to general construction activities. There would be short-term, temporary noises associated with the development of infrastructure, which would contribute to long-term, localized noise impacts in the planning area under all alternatives.

Alternative A

Under Alternative A, oil and gas development would be subject to current management as approved in the February 2013 NPR-A IAP Record of 17 Decision (ROD). Approximately 11.8 million subsurface acres and 1,154,000 surface acres of high potential area would be available for oil and gas leasing. Existing protections for surface resources would remain in place. Some amount of increase in the ambient noise environment would occur under Alternative A as a result of future oil and gas development in the NPR-A, particularly on already leased tracts in the high potential area (see **Map B-1** in **Appendix B**), and noise impacts from existing oil and gas infrastructure located within noise sensitive areas would continue. Noise sensitive areas that occur within or adjacent to lands currently open to fluid mineral leasing include portions of the Nuiqsut and Utqiaġvik subsistence use areas; the communities of Atqasuk, Nuiqsut, and Utqiaġvik; recreational areas along the southern NPR-A near the Colville River north of its confluence with the Etivluk River; and at locations used by wildlife throughout the high potential area as described in **Table 3-11**. Lands currently closed to fluid mineral leasing include the Teshekpuk Lake area, which is a recreational area and includes portions of the Nuiqsut and Utqiaġvik subsistence use areas.

In addition to the high potential area, the NPR-A contains a number of subsistence use areas throughout the planning area that would continue to be susceptible to noise impacts. These subsistence use areas include both areas open to leasing and areas where non-oil and gas-related activities, such as infrastructure development, would occur. Much of the area of high hydrocarbon potential shows moderate to high overlapping use by the communities of Nuiqsut and Utqiaġvik; Nuiqsut areas of moderate to high overlap are to the east and southeast of Teshekpuk Lake (Appendix T, **Map T-4**), and Utqiaġvik areas of moderate to high overlap are to the south and west of Teshekpuk Lake (Appendix T, **Map T-6**). Atqasuk use areas generally are to the west of the areas of high hydrocarbon potential but encompass most of the area of medium hydrocarbon potential (Appendix T, **Map T-3**).

Noise impacts under Alternative A would continue to be associated with non-oil and gas-related development as well as post-lease development activities described under *Impacts Common to All Alternatives*, which include general construction activities, the construction and operation of permanent onshore infrastructure, new road construction, gravel mining and associated blasting, the use of vehicles and equipment to construct wells, drilling and hydraulic-fracturing equipment during oil and gas production, and operations of central processing facilities. Noise associated with the development of coastal infrastructure and marine vessel traffic would be as described under *Impacts Common to All Alternatives.*

Trends in aircraft activity and associated noise effects would continue under Alternative A as oil and gas development continues. As shown in **Table 3-9**, industry-related aircraft takeoffs and landings exceeded federal government activity for the first time in 2015 and 2016, with activity concentrated around Nuiqsut. Aircraft-related noise would likely increase over time under Alternative A, with some years having more activity than others depending on the phases of new development. Overflights from Kuparuk to developments in the NPR-A and their associated noise impacts would continue to occur.

Table 3-11
Summary of Noise Effects for All Alternatives

Receptor	Sensitive Resource Location/Timing	Noise Source	Noise Source Disturbance Duration (Phase)
Human Receptors			
Subsistence Users	Nuiqsut and Utqiaġvik subsistence use areas	Aircraft	Short-Term, Intermittent (All Phases)
		Infrastructure	Short-Term (E, AR); Long-Term (D, P)
Residents	Community of Nuiqsut	Aircraft	Short-Term, Intermittent (E, D, AR); Long-term, Intermittent (P)
	Community of Utqiaġvik (barge landing only)	Infrastructure	Short-Term (E, D); Long-Term (P)
Recreational Users	Colville River area and Teshekpuk Lake	Aircraft	Short-Term, Intermittent (E, D, AR) Long-term, Intermittent (P)
		Infrastructure	Short-Term, Intermittent (E); Long-Term (D, P)
Biological Receptors			
Caribou	Throughout the high potential area, as well as the larger planning area, during calving and post-calving activities	Aircraft	Short-Term (All Phases)
		Infrastructure	Short-Term (E); Long-Term (D, P)
Polar Bears	At maternal denning locations during the winter throughout the high potential area, as well as the larger planning area. Nearshore areas during summer and fall.	Aircraft	Short-Term (All Phases)
		Infrastructure	Short-Term (E); Long-Term (D, P)
Seals	Nearshore areas during summer and winter. Year-round in areas of flat ice near the edge of the shorefast ice zone in the Beaufort Sea. On sea ice during pupping in the winter and early spring, molting in early summer, and resting throughout the year.	Aircraft	Short-Term (All Phases)
		Infrastructure	Short-Term (E); Long-Term (D, P)
Whales	Within marine transit route	Marine Traffic	Short-Term (D)
	In transit past the planning area during spring (April–June) and fall (September and October) migration, traveling along the shelf break and coming close to shore to feed	Barge landing/ seawater treatment plant	Long-Term (D, P)
Migratory Birds	Throughout the high potential area, as well as the larger planning area, during breeding and brood-rearing activities	Aircraft	Short-Term (All Phases)
		Infrastructure	Short-Term (E); Long-Term (D, P)

Notes: E (exploration); D (development); P (production); AR (abandonment/reclamation)

Alternative B

Under Alternative B, approximately 11.4 million subsurface acres (0.3 million fewer acres than Alternative A) and 1,094,000 surface acres of high potential area (60,000 fewer acres than Alternative A) would be available for leasing. Noise-sensitive areas that would be made unavailable compared with Alternative A include the areas around Utqiaġvik and Atqasuk, areas west of Nuiqsut, and portions of the Utqiaġvik and Nuiqsut subsistence use areas. While areas around Utqiaġvik and Atqasuk would be unavailable, they are outside the high potential area and development is not expected to occur in these areas regardless of their availability. Making areas unavailable west of Nuiqsut could reduce post-lease development and aircraft-related overflights and their associated noise impacts compared with Alternative A. Approximately 11 percent of the Utqiaġvik and 17 percent of the Nuiqsut subsistence use areas would be open to infrastructure development, compared with 14 percent of the Utqiaġvik and 27 percent of the Nuiqsut subsistence use areas under Alternative A. Noise impacts on subsistence users at cabins, fish camps, and other subsistence use areas would be reduced in these newly closed areas.

In addition to the high potential area, the NPR-A contains a number of subsistence and recreational use areas throughout the planning area that would be susceptible to noise impacts under Alternative B. These areas include areas open to leasing as well as areas where non-oil and gas activities, such as infrastructure development, would occur. Human receptors who could be affected by such activities include residents of NPR-A communities, subsistence users of subsistence areas, and recreational users throughout the entire NPR-A. In the case of Nuiqsut, fewer acres would be in core subsistence use areas of moderate to high overlapping use under Alternative B; increased setbacks along popular river corridors, as well as NSO leasing stipulations along rivers and deep-water lakes, would reduce impacts on recreational users. A more detailed description of the full geographic extent and degree to which subsistence and recreational users would be affected is presented in **Section 3.4.3** and **Section 3.4.6**.

Under Alternative B, ROP F-4 would reduce the impacts of aircraft traffic noise on North Slope subsistence hunters by suspending nonessential helicopter flights during peak caribou hunting within 2 miles of heavily used subsistence rivers or limit helicopter traffic during this time to flight corridors that minimize. Similarly, ROP I-1 potentially would result in some reduction in aircraft traffic noise on North Slope subsistence hunters by including information for aircraft personnel concerning subsistence activities and areas/seasons that are particularly sensitive to disturbance by low-flying aircraft.

Overall, noise impacts under Alternative B would continue to be associated with non-oil and gas-related and post-lease development activities described under *Impacts Common to All Alternatives*, including general construction activities, noise associated with the development of coastal infrastructure, and marine vessel traffic, though in potentially fewer areas and with fewer noise impacts compared with Alternative A. Noise-related impacts on wildlife in the high potential area and throughout the remainder of the planning area, including impacts from aircraft overflights, would likely be less than under Alternative A.

Alternative C

Under Alternative C, approximately 17 million subsurface acres (5.3 million more acres than Alternative A) and 1,394,000 surface acres of high potential area (240,000 more acres than Alternative A) would be available for leasing. Noise sensitive areas that occur within or adjacent to lands open to fluid mineral leasing would be similar to Alternative A and include portions of the Nuiqsut and Utqiaġvik subsistence use areas; the communities of Atqasuk, Nuiqsut, and Utqiaġvik; recreational areas along the southern NPR-A near the Colville River north of its confluence with the Etivluk River; and locations used by wildlife throughout the high potential area. Areas of high potential newly available under Alternative C include

240,000 more acres around Smith Bay and south of the Teshekpuk Lake area, and noise impacts on human and wildlife receptors in these areas may be greater than under Alternative A. Approximately 16 percent of the Utqiaġvik and 27 percent of the Nuiqsut subsistence use areas would be open to infrastructure development, compared with 14 percent of the Utqiaġvik and 27 percent of the Nuiqsut subsistence use areas under Alternative A. While more acres in these subsistence areas would be available for leasing, actual noise impacts on subsistence users at cabins, fish camps, and other subsistence use areas may be similar under Alternatives A and C given the similar acres open to infrastructure.

In addition to the high potential area, the NPR-A contains a number of subsistence use areas throughout the planning area that would be susceptible to noise impacts under Alternative C. These subsistence use areas include areas open to leasing as well as areas where non-oil and gas activities, such as infrastructure development, would occur.

Human receptors who could be affected by such activities include residents of NPR-A communities, subsistence users of subsistence areas, and recreational users throughout the entire NPR-A. Under Alternative C, a larger area would be open to infrastructure development in the southwestern portion of the NPR-A along the upper Colville River, which is primarily used for furbearer hunting by North Slope communities. Alternative C would also decrease setbacks along popular recreational corridors, thereby increasing the potential for visitor displacement. A more detailed description of the full geographic extent and degree to which subsistence and recreational users would be affected is presented in **Section 3.4.3** and **Section 3.4.6**.

Under Alternative C, ROP F-4 and ROP I-1 would reduce noise impacts in the same way as described under Alternative B.

Overall, noise impacts under Alternative C would be associated with non-oil and gas-related and post-lease development activities described under *Impacts Common to All Alternatives*, including general construction activities, noise associated with the development of coastal infrastructure, and marine vessel traffic, though in more areas and with greater noise impacts compared with Alternative A. Noise-related impacts on wildlife in the high potential area and from aircraft overflights likely would increase compared with Alternative A due the likelihood of increased oil and gas development. Noise-related impacts throughout the remainder of the planning area would also increase, but to a lesser degree. Implementing the ROPs described above would help reduce impacts on subsistence use and subsistence resources more than under Alternative A, which does not include such ROPs.

Alternative D

Under Alternative D, approximately 18.3 million subsurface acres (6.6 million more acres than Alternative A) and 1,409,000 surface acres of high potential area (255,000 more acres than Alternative A) would be available for leasing. All noise sensitive areas in the high potential area would be open to fluid mineral leasing, including Teshekpuk Lake, though it would be unavailable for new infrastructure. While noise would continue from non-oil and gas-related activities, noise impacts on sensitive receptors from post-lease development would likely be greater than under Alternative A and the greatest of all alternatives due the increased opportunities for post-lease development in the high potential area. Approximately 17 percent of the Utqiaġvik and 29 percent of the Nuiqsut subsistence use areas would be open to infrastructure development, compared with 14 percent of the Utqiaġvik and 27 percent of the Nuiqsut subsistence use areas under Alternative A. While more acres in these subsistence areas would be available for leasing, actual noise impacts on subsistence users at cabins, fish camps, and other subsistence use areas may be similar under Alternatives A and D given the similar acres open to infrastructure.

In addition to the high potential area, the NPR-A contains a number of subsistence use areas throughout the planning area that would be susceptible to noise impacts under Alternative D. These subsistence use areas include areas open to leasing as well as areas where non-oil and gas activities, such as infrastructure development, would occur. Human receptors who could be affected by such activities include residents of NPR-A communities, subsistence users of subsistence areas, and recreational users throughout the entire NPR-A. Alternative D would further increase the likelihood of impacts on subsistence users, as the percentage of use areas open to oil and gas leasing would also be higher for Atqasuk (94 percent of use areas), Utqiaġvik (48 percent), Nuiqsut (40 percent), and Wainwright (39 percent). For recreational users, decreased setbacks along popular recreational corridors would increase the potential for visitor displacement. A more detailed description of the full geographic extent and degree to which subsistence and recreational users would be affected is presented in **Section 3.4.3** and **Section 3.4.6**.

Under Alternative D, ROP F-4 and ROP I-1 would reduce noise impacts in the same way as described under Alternative B.

Overall, noise impacts under Alternative D would be associated with non-oil and gas-related and post-lease development activities described under *Impacts Common to All Alternatives*, including general construction activities, noise associated with the development of coastal infrastructure, and marine vessel traffic, though in more areas and with greater noise impacts compared with Alternative A. Noise-related impacts on wildlife in the high potential area and from aircraft overflights likely would increase compared with Alternative A due to the likelihood of increased oil and gas development. Noise-related impacts throughout the remainder of the planning area would also increase, but to a lesser degree. Implementing the ROPs described above would help reduce impacts on subsistence use and subsistence resources more than under Alternative A, which does not include such ROPs. However, noise impacts under Alternative D would likely be the highest of all alternatives.

Cumulative Impacts

The analysis area for cumulative effects of noise is the same as the analysis area: the high potential area; the marine transit route; areas under aircraft flight routes; and the coastal infrastructure development areas; and subsistence use areas that overlap the high potential area. Combined, these locations comprise the area in which noise from post-lease activities could be noticeable to sensitive receptors when combined with potential reasonably foreseeable future actions (RFFAs). The temporal scope of cumulative noise effects extends from the time frame of industrial development on the North Slope to 70 years from the anticipated initiation of this plan.

Noise is unique when evaluating cumulative effects, because it only occurs when the noise-generation is occurring. In addition, the level of noise is influenced by the distance between a noise source and the receiver. Furthermore, louder noises tend to dominate noise levels; therefore, the cumulative effect of other noise sources may be masked by the loudest noise source

Past activities have increased ambient sound levels in portions of the North Slope, including those resulting from existing development in the NPR-A, development on state lands on the Prudhoe Bay Oil Field, offshore drilling activities, and surface, air, and marine transportation. Present oil and gas development on the North Slope could result in localized but additive impacts on the acoustic environment from exploration and operations and related air traffic levels in the region such as those which originate from airfields located in the Colville River delta (Alpine, Colville Delta- 3, and Helmericks) and out of private and public airports. Planned future activities include onshore North Slope oil and gas exploration, development, and production; off-shore oil and gas development in state and federal waters (Beaufort Sea, Smith Bay, Harrison Bay); non-oil and gas-related surface, air, and marine transportation; and development in the communities of Atqasuk, Nuiqsut, and Utqiaġvik (see **Appendix F, Section F.3.2**). In addition, aircraft activity as described in **Table 3-9** would continue to be a source of noise in the analysis area, likely at generally increasing levels over time but with variations in levels of activity from year to year.

All of the IAP alternatives, with the exception of Alternative B, would increase ambient noise levels in the high potential portion of the analysis area. When this increase in sound level is combined with effects of past, present, and RFFAs, there would an incremental increase in long-term noise levels, especially noise sources that are closer to Nuiqsut, subsistence use areas, or other noise-sensitive locations. Cumulative contributions to noise associated with non-oil and gas-related activities would continue to occur under all alternatives. Intermittent noises, such as blasting at gravel mine sites, may occur concurrently with other projects, or may increase the overall frequency of disturbances to the community of Nuiqsut and in subsistence use areas in the high potential area.

3.2.4 Renewable Energy

Affected Environment

Wind Resources

The BLM encourages the development of wind energy consistent with the Energy Policy Act of 2005, BLM Energy and Mineral Policy (August 26, 2008).

The Department of Energy's Wind Program and National Renewable Energy Laboratory evaluate wind energy potential according to wind power classes, which are based on typical wind speeds. These classes range from Class 1 (the lowest) to Class 7 (the highest). In general, at 164 feet, wind power Class 4 or higher can be useful for generating wind power with large turbines and are considered good resources. Some Class 3 areas could have higher wind power class values at 262 feet than shown on the 164-foot map because of possible high wind shear (DOE 2001). Given the advances in technology, some locations in Class 3 areas may be suitable for utility-scale wind development. Primary criteria for wind development outlined in the Assessing the Potential for Renewable Energy on Public Lands (BLM and DOE 2003) included a wind power Class 4 and above for short term, Class 3 and above for long term, and transmission access within 25 miles and road access within 50 miles.

Within the planning area, wind potential is generally poor to fair (Class 1–3); however, along the coastline and immediately offshore, wind power classes range from 3 to 6 (Doubrawa et al. 2017). Along the coast, the potential for small-scale wind energy development is moderate. The potential for local communities located along the coast within the planning area to use wind as a small-scale supplemental energy source is high. Many communities in the planning area rely on high-cost, diesel-powered stations to generate electricity. Using small-scale wind turbines along with diesel generation can save fuel. To be effective, small-scale generation sites need to be in areas with high wind energy potential that are close to communities.

Small wind turbines also are used to supply remote meteorological stations with power in order to recharge battery banks. Wind power provides a critical source of power to these stations during the darkest months of November through January when solar energy is insufficient to charge battery banks. Utility-scale sites need to be in areas with high wind energy potential that are near existing transmission infrastructure.

Most of the land around villages is owned by Alaska Native Claims Settlement Act (ANCSA) corporations, and the BLM manages very little land adjacent to communities or near existing transmission lines. Most BLM-managed land in the planning area is inland and generally has only poor to fair wind potential (DOE

2006; Doubrawa et al. 2017). Future utility-scale and small-scale wind energy development in the planning area is most likely to occur near native villages along the coastline, rather than on BLM-managed lands.

Solar Resources

The potential for utility-scale solar operations on BLM-managed lands in the planning area is low. One of the criteria outlined in Assessing the Potential for Renewable Energy on Public Lands (BLM and DOE 2003) is a solar resource of at least 5 kilowatt hours per square meter per day. This criterion is not met anywhere within the planning area (DOE 2008a and 2008b); however, small-scale solar panel arrays are commonly utilized by remote weather and gauging stations within the planning area.

Biomass

The biomass program (BLM 2019) is the use of organic matter waste products for production of products such as paper and pulp, value-added commodities, and bioenergy or bio-based products such as plastics, ethanol, or diesel. Alaska's most important biomass fuels are wood, sawmill wastes, fish byproducts, and municipal waste (Alaska Energy Authority 2009). There are no trees, wood, or sawmill wastes in the planning area.

The potential for the use of biomass from BLM-managed lands within the planning area is extremely limited. Most BLM-managed lands are remote, difficult to access, and too far from population centers to make use of biomass economically. Fuel reduction projects adjacent to villages can be a source of biomass for energy or fuel, but no vegetation treatments have been conducted in the past; the probability of future treatments on BLM-managed land is low.

Geothermal

Alaska has a number of documented shallow sources of heat along its southern margin and in the central part of the state; however, there are no known geothermal sites in Alaska north of the Brooks Range (BLM 2008).

While there are no geothermal energy production facilities or wells in the planning area, there are sedimentary basins underlying the North Slope, which have excellent porosity and permeability. If the geothermal gradient is sufficient, hot fluid can be produced from these formations. For example, the reservoir temperature at Prudhoe Bay at a 7,500- to 8,000-foot depth is approximately 180 to 200 degrees F. Depending on the geothermal gradient of the basin and the relic permeability at depth, production of this hot water may become a viable small-scale energy source for oil field operations or communities in the immediate area. However, the high cost of drilling and permeability enhancement, along with relatively low geothermal temperatures, make it unlikely that geothermal energy resources would be developed on a stand-alone basis (Alaska Energy Authority 2009).

Direct and Indirect Impacts

No significant development of renewable energy resources is likely to occur on BLM-managed lands in the planning area. Due to no renewable energy development expected, the selection of an alternative will have no impact on renewable energy.

Cumulative Impacts

No cumulative impacts are anticipated.

Because there is no anticipated renewable energy development, the effects of climate change described in the *Affected Environment* above would not affect renewable energy in the project area.

3.2.5 Physiography

Affected Environment

Physiography can be described as the classification of large-scale landforms within a given area. The NPR-A analysis area is divided by three major physiographic regions of Alaska: the Arctic Coastal Plain, Arctic Foothills, and the Arctic Mountains (Wahrhaftig 1965; **Map 3-1**). The analysis area is a high-latitude arctic environment. Throughout the three physiographic provinces in the planning area there are no glaciers, and continuous permafrost underlies the entire area. Detailed descriptions of each of the physiographic regions are presented in Section 3.2.4 of the 2012 NPR-A Final IAP/EIS (BLM 2012).

Climate Change

Northern environments, including the NPR-A analysis area, have experienced warming over the last half-century (SNAP 2019). This trend is expected to continue as climate models predict that high northern latitude regions will experience the greatest warming temperatures of the globe (IPCC 2014). Trends that are reflected in climate change modeling were conducted for the planning area by the Scenarios Network for Alaska Planning (SNAP) group at the University of Alaska Fairbanks (SNAP 2019). Permafrost degradation, the decrease in thickness and/or areal extent of permafrost, is anticipated within the analysis area. The Arctic Coastal Plain Province, dominated by features and processes driven by permafrost, has the potential to change greatly with the anticipated degradation and thaw of permafrost. Thawing permafrost causes changes to surface hydrology, soil drainage, vegetation and wildlife habitats, and greenhouse gas emissions (Jorgenson et al. 2015).

Direct and Indirect Impacts

Impacts Common to All Alternatives

Future construction of infrastructure for both non-petroleum and petroleum-related development would affect topography in the program area and could reshape geomorphological features, such as waterbodies and permafrost features. Activities such as sand and gravel extraction, changes to topographic features, or construction of infrastructure for non-oil and gas facilities will have similar impacts to those of oil and gas development. The effects of climate change described in the *Affected Environment*, above, could influence the rate or degree of the potential direct and indirect impacts.

All the alternatives would require placement of gravel fill, which would have the potential direct impact of altering the topography within the development footprint. Gravel infrastructure would include pads, roads, and an airstrip, as described in **Appendix B**, **Section B.5**. The acreage is comprised of approximately 50 acres per central processing facility, 15 acres per satellite well pad, 7.5 acres of roads, 0.04 acres in vertical support members for pipelines, and 15 acres for seawater treatment infrastructure. Gravel mine surface disturbance is estimated to be about 26.8 acres per 1 million cubic yards of gravel. This potential long-term impact would begin during the construction phase and would last throughout the development phase until the gravel is removed and the site has been restored to preprogram conditions. Impacts would last longer if not all gravel infrastructure (e.g., access roads) are removed.

In addition to the potential direct effects on topography that would result from placement of gravel fill, the presence of gravel infrastructure would alter existing geomorphic features. Gravel infrastructure could affect permafrost features or result in changes to stream or lake morphology. Potential direct and indirect impacts on permafrost features are further described in **Section 3.2.9**, Soil Resources. Potential direct and indirect impacts on surface water features are further described in Section **3.2.11**, Water Resources.

Most, but not all, of the surface disturbance is associated with placement of gravel fill. The footprint of gravel infrastructure would vary, depending on the alternative (see discussion of each alternative below). All the action alternatives would include potential future development of a gravel mine or mines, which would also result in potential direct long-term impacts on topography. Impacts of gravel mining on physiography would last beyond the development phase because the pits remaining from gravel extraction would typically not be completely backfilled, and any remaining depression could fill with water and become a permanent lake. Gravel mines are described further in **Section 3.2.10**.

Future ice infrastructure (e.g., pads and roads) would have negligible impacts on topography but could affect permafrost and surface water geomorphic features, as discussed further in **Section 3.2.11**, Water Resources and **3.2.9**, Soil Resources. **Section 3.2.6**, Geology and Minerals addresses potential changes to physiography associated with geologic hazards (e.g., subsidence or slope failure).

The effects of climate change described under the *Affected Environment*, above, are part of the baseline conditions for physiography in the project area. See **Section 3.2.1** for a detailed discussion of the alternatives' contributions to global climate change.

Alternative A

Under Alternative A, current management actions would be maintained, as described in the 2012 NPR-A Final IAP/EIS. Approximately 1,375 acres of surface disturbance would occur under Alternative A with a gravel need of 8,794,000 cubic yards.

Alternative B

Approximately 1,236 acres of disturbance would occur under Alternative B with a gravel need of 7,904,000 cubic yards. This would result in an estimated surface impact of 294,925 acres. Alternative B would make available the least amount of acreage to new infrastructure development and of all the alternatives, it would require the least amount of sand and gravel.

Alternative C

Approximately 1,736 acres of disturbance would occur under Alternative C with a gravel need of 11,098,000 cubic yards. This would result in an estimated surface impact of about 414,100 acres. The surface impact under Alternative C is greater than it is under Alternatives A and B.

Alternative D

Approximately 2,385 acres of disturbance would occur under Alternative D with a gravel need of 15,250,000 cubic yards. This would result in an estimated surface impact of approximately 569,000 acres, a greater amount of estimated surface impact than Alternatives B and C. Alternative D makes available the greatest acreage for new infrastructure and requires the highest amount of gravel resources.

Cumulative Impacts

Potential impacts on topography and geomorphic features resulting from future gravel infrastructure are generally localized to the footprint or adjacent area; therefore, the geographic area relevant for assessing cumulative impacts on physiography is the program area. While other past, present, and RFFAs in the NPR-A (**Appendix F**, **Section F.3.2**) have had or would have impacts on physiography, none of these actions have been or are proposed to be in the program area; therefore, they would not contribute to cumulative impacts on physiographic features in the NPR-A. The effects of climate change described under the *Affected Environment*, above, could influence the rate or degree of the potential cumulative impacts.

3.2.6 Geology and Minerals

Affected Environment

Geology

An overview of the general geology within the NPR-A is described in the 2012 NPR-A Final IAP/EIS (BLM 2012). Limited additional information is available since the writing of the 2012 NPR-A Final IAP/EIS, and there have been limited to no changes in the geology.

Geologic Hazards

Earthquakes and Surface Faults

The U.S. Geological Survey (USGS) has prepared seismic hazard maps for Alaska that portray the probability of ground motion and peak ground acceleration due to an earthquake. For the NPR-A, the USGS estimates peak ground accelerations of 0.041g (where g equals the acceleration due to gravity); there is a 5 percent probability that this acceleration would be exceeded in 50 years; thus, the NPR-A is in an area of relatively low seismic risk (USGS 2019).

Slope Failure

Slope failure in the NPR-A can occur in the form of solifluction and creep or slump along coastal bluffs, terrace escarpments, lake margins, and ridge slopes. Retrogressive thaw slumps are slope failures resulting from thawing, ice-rich permafrost.

Subsidence

The volume of ice in permafrost soils, particularly in the first few tens of feet below the ground surface, can be several times the volume of the mineral components (Brewer 1987). Natural and human-induced thawing of this near-surface ice generally results in uneven lowering of the ground surface, which may lead to water ponding or preferential erosion, or both (Rawlinson 1993). Because of the presence of ice-rich permafrost, about two-thirds of the NPR-A has the potential for thaw settlement of 16 to 98 feet (Jorgenson et al. 2015).

Sea Ice Ride-up and Override

Ice shove, or override, is a phenomenon that can alter bathymetry and topography, and impact local infrastructure. Summer uncovers the resulting ice scars on the tundra and large slabs of shoved material along the coastline.

Override can be broken down into two processes: onshore ride-up and pile-up. Onshore ride-up is the process in which ice climbs up a beach, sometimes hundreds of feet, as a sheet of ice. The motion tends to be horizontal and occur in areas with gentle sloping beaches. Pile-up is a more vertical movement due to the process in which a ridge of broken ice blocks topples onto land.

Override can occur any time of the year, but most often occurs during freeze-up and break-up. It is thought to be caused by environmental conditions such as offshore ice pressure, wind, sea temperature, and bathymetry (Mahoney et al. 2004). Local Utqiaġvik observations suggest the most hazardous ice override conditions are from a strong southwest wind combined with a high tide and westward currents (USAED 1999). Ride-ups are typically less than 165 feet; ride-ups greater than 330 feet are rare. Onshore pile-ups are typically less than 33 feet, and up to 66 feet are rare (USDOI MMS 2008).

Numerous observations of ice shove include a 1980 ice pileup near Cape Hackett extending 985 feet with large ice blocks found up to 98 feet inland, the 20 to 23 feet bluffs near Drew Point overtopped by an ice pileup up 10 feet high and overridden 246 feet inland, and 1,640 feet of override near Point Lonely in 1981

(Kovacs 1983). Utqiaġvik has the most extensive record of ice shoves ranging from 16 to 1,296 feet (Mahoney et al. 2004).

Coastal Erosion and Storm Surge

Coastal sediment transport varies seasonally and locally depending on storm intensities, frequencies, distance to the ice edge, sea temperatures, and local sea level. Northeast winds are predominant and drive sediment west, with autumn storms generating some eastward transport. The majority of shorelines within the decision area are retreating with the exception of some areas in the river deltas and sandy barrier extensions, which are accreting (Gibbs and Richmond 2017).

In general, coastlines with low mud-rich bluffs with high ice content erode more quickly than coastlines with steep bluffs and coarser sediments; the Beaufort Sea coast is eroding more quickly than the Chukchi Sea coast. The area between Utqiaġvik and Dease Inlet has an average long-term erosion rate of 8.2 feet per year. Further east, between Dease Inlet and Smith Bay, the erosion rate is 10.5 feet per year (Gibbs and Richmond 2017).

Eastward, the area between the Ikpikuk River delta to Cape Halkett has experienced the highest average rate of erosion at 19.4 feet per year, along with the largest short-term erosion at 80 feet per year, between McLeod Point and Avatanak Bight. Coastal erosion near Drew Point, in particular, is well studied due to its alarming progression, estimated initially at 22.6 feet per year in 1955 to the current estimate of 62 feet per year (Ravens et al. 2011; Barnhardt et al. 2010; Wobus et al. 2011). The Teshekpuk Lake Special Area lies in the Arctic Coastal Plain between Smith Bay and Harrison Bay; between 1955 and 2002, the coastal erosion rate averaged 18.4 feet per year (Jones 2018).

Eastward, the average erosion rate from Cape Halkett to the Colville River is 3.5 feet per year due to the periodic accretion in the Colville River delta, which can reach 40 feet per year (Gibbs and Richmond 2017).

Coastal erosion is accelerating due to several factors:

1) An increase in the duration of active erosion due to a longer period of open water during the summer months, since the sea ice is melting earlier and forming later
2) An increase in the distance offshore to the ice edge, which allows larger waves to generate and erode the shoreline
3) Warmer sea temperatures, which melt the permafrost in the coastal bluffs and cause niches and block collapse
4) More frequent storm events and storm surge

Storm surges are high rises in sea level caused by winds pushing water onshore above normal tidal elevation. The areas with low-lying coastal bluffs are more susceptible to coastal flooding; salt water inundation of adjacent lakes from the surging water and the storm surge can also be responsible for driving ice onshore (Reimnitz and Maurer 1979). In areas with high coastal bluffs, the surface winds from the west raise water levels and produce storm surges that allow the water to access and melt permafrost and erode sediment until the overlaying bluff collapses. This erosion mechanism was recorded and studied at Drew Point (Barnhardt et al. 2010).

Minerals

The state of mineral resources is described in the Affected Environment chapter of the 2012 NPR-A Final IAP/EIS (BLM 2012). Very little has changed in the knowledge of or usage of mineral resources in the decision area since the publication of that document. With the exception of mineral materials mining, which is discussed in **Section 3.2.10**, no new mining for minerals is anticipated to occur in the planning area.

Climate Change

Climate change will not affect the existence or location of hardrock or coal mineralization. If development of these resources were to be allowed within the NPR-A, techniques for accessing and extracting those resources would have to take into consideration mine development in a changing climate. Mining in Alaska, particularly in the northern latitudes, involves the use of ice roads, snow trails, and ice pads for transportation of equipment to and from the mineralized location, usually during the exploration and mine development phases.

As the climate changes, the methods of mining might change as well. A warmer climate could lengthen the mining seasons; a cooler climate could shorten the mining season, or force the miners to change their methods to allow mining during the winters while the ground is frozen. When developing a mineralized location into a mine, there are a multitude of factors to take into consideration. Attempting to second-guess the future of the climate throws an entirely different set of variables into that development process. Depending on the type of material and the mining method used to extract that material, a changing climate could make the excavation easier, due to the melting of the permafrost. It could make it more difficult when attempting to develop deposits in areas with melted permafrost, which may create water removal issues or the need for excavation in swampy conditions. See the North Slope Climate Analysis (SNAP 2018) for an analysis of the type of impacts that might be seen.

Direct and Indirect Impacts

Impacts Common to All Alternatives

As described above, bedrock is minimally exposed across much of the NPR-A; therefore, existing bedrock outcrops are highly valuable in developing the best possible surface and subsurface geologic understanding of the area. Oil and gas exploration, development, and production could also affect the risk of several geologic hazards identified in the *Affected Environment* section, including seismicity, slope failure, and subsidence. Future development of petroleum resources would include injection of seawater or gas into the production field to maintain reservoir pressure. Also, wastewater, produced water, spent fluids, and chemicals would be disposed of in injection wells. Injection of large volumes of fluids into low permeability and brittle rocks has the potential to trigger low-level seismicity (earthquakes). This phenomenon is generally associated with the high volumes of waste injection associated with the high density of wells needed to fully develop tight, unconventional resource plays, such as shale source rocks, rather than conventional hydrocarbon production. The potential for induced seismicity associated with the action alternatives would be low.

Slope failure could be triggered or exacerbated by placement of gravel fill in the future. Most of the decision area is relatively flat, and gravel infrastructure would not likely be placed on slopes with the potential for ground movement. At waterbody crossings, roads would be constructed using methods that would minimize potential slope failure along stream banks; therefore, the potential for leasing and development to influence slope failure risk would be low. Likewise, slope failure is unlikely to affect infrastructure associated with oil and gas exploration, development, and production.

Subsidence associated with thawing permafrost could adversely affect oil and gas infrastructure. To minimize the potential for subsidence associated with thawing of near-surface ice, gravel pads and roads would be constructed with a thickness sufficient to maintain a stable thermal regime. Future pipelines would be constructed primarily aboveground and would not contribute to permafrost thaw. All future buildings would be supported aboveground on pilings to accommodate ground settling or frost heaving.

As described in **Section 3.2.10**, the project area does not have abundant sand and gravel resources suitable for development. Mining these resources could change surface and subsurface drainage patterns and affect permafrost in the surrounding area.

The effects of climate change described in the *Affected Environment*, above, could influence the rate or degree of the potential direct and indirect impacts. The effects of climate change described under the *Affected Environment*, above, are part of the baseline conditions for geology and minerals in the project area. See **Section 3.2.1** for a detailed discussion of the alternatives' contributions to global climate change.

Alternative A

Under this alternative, mineral material resources would continue to be available for mining of mineral materials (sand and gravel) required for development of oil field infrastructure, such as roads and drill pads. Under this alternative, the BLM would allocate mineral material resources on a case-by-case basis. The development of mineral material resources could result in the loss of fossil resources and outcrop areas that promote geologic understanding of the area; however, mineral materials mining could also expose new fossils and outcrops that have the potential to further the understanding of the geologic history of the area. Under this alternative up to 236 acres could be disturbed by gravel mining needed to supply expected petroleum developments, which could result in impacts on geological resources.

Impacts Common to All Action Alternatives

Under all action alternatives, mineral resources in some areas would be available for mining of sand and gravel required for development of oil field infrastructure, such as roads and drill pads. Under all action alternatives, 61,000 acres in the planning area would be closed to sand and gravel mining, and 9,630,000 acres would be open to sand and gravel mining. The development of mineral material resources could result in the loss of fossil resources and outcrop areas that promote geologic understanding of the area; however, mineral materials mining could also expose new fossils and outcrops that have the potential to further the understanding of the geologic history of the area.

Alternative B

Under this alternative, up to 212 acres could be disturbed by gravel mining needed to supply expected petroleum developments, which is a reduction of 24 acres of disturbance compared with Alternative A. This could result in impacts on geological resources, such as the destruction of outcrops and fossil resources, and a loss of these resources for other development uses.

Alternative C

Under this alternative, up to 297 acres could be disturbed by gravel mining needed to supply expected petroleum developments, which is an increase of 61 acres of disturbance compared with Alternative A. This could result in impacts on geological resources, such as the destruction of outcrops and fossil resources, and a loss of these resources for other development uses.

Alternative D

Under this alternative, up to 409 acres could be disturbed by gravel mining needed to supply expected petroleum developments, which is an increase of 173 acres of disturbance compared with Alternative A. This could result in impacts on geological resources, such as the destruction of outcrops and fossil resources, and a loss of these resources for other development uses.

Cumulative Impacts

The effects of climate change described under the *Affected Environment*, above, could influence the rate or degree of the potential cumulative impacts. The time frame for the cumulative impacts analysis spans from the 1970s through full realization of the hypothetical development scenario, which is anticipated to occur approximately 70 years after the ROD for this EIS has been signed for the Alaska North Slope on geology and minerals. Additional petroleum-associated and non-petroleum-associated development projects that require sand and gravel will result in the destruction of geologic features, but may also further the geologic understanding of the area.

3.2.7 Petroleum Resources

Affected Environment

Oil resources in the NPR-A are concentrated in the east and northeastern part of the planning area. Natural gas resources are thought to exist across the northern part of the planning area. Ongoing and anticipated future oil developments are discussed below. Development of natural gas resources is unlikely but is discussed due to proposed plans to construct gas pipelines to the North Slope of Alaska.

Alpine Colville Delta-5 is a satellite of the Alpine processing unit. It is a currently operating development located on Alaska Native lands within the NPR-A boundaries. Alpine Colville Delta-5 produces approximately 37,000 barrels of oil per day from the Colville River unit (ConocoPhillips 2019a).

Greater Mooses Tooth One (GMT1) is also a satellite of the Alpine processing unit; it came online in late 2018 and is producing from federal leases and Alaska Native lands. It is estimated that peak production will reach 25,000 to 30,000 barrels of oil per day (ConocoPhillips 2019b).

GMT2 is a planned Alpine satellite. Construction and drilling are ongoing, with 36 wells permitted in the initial development phase and an expansion to a total of 48 wells planned. Production will occur from both federal minerals and Alaska Native minerals. Peak production is projected to be 35,000 to 40,000 barrels of oil per day (ConocoPhillips 2019c). Conoco Phillips expects to conduct additional seismic testing in support of GMT1 and GMT2 in the near future.

Willow is a planned development in the Bear Tooth Unit. The permitting process for the location is ongoing. The initial development is slated to include a central processing facility and at least 50 wells with a 20-foot wellhead spacing located on 4 drill pads (BLM 2018a). First oil production is planned for 2024–2025. When operational, it is estimated that Willow could produce in excess of 100,000 barrels of oil per day (ConocoPhillips 2019d).

Umiat is a historic field that was first explored in 1944 by the U.S. Navy. Twelve exploration and delineation wells have been drilled. Shallow oil was discovered in the Grandstand formation. Information from wells suggests that a larger pool exists below with an estimated 1.2 billion barrels in place (Bradner 2015). No development is planned at this time, and the distance to infrastructure (92 miles to the TAPS) would require a substantial investment for initial development. The BLM has recently received an application for an exploration unit in the Umiat area.

Smith Bay is located on the northeast coastline of the NPR-A. Caelus Energy Alaska LLC announced in 2018 results of three-dimensional seismic testing and two test wells that estimated 6 to 10 billion barrels of oil in place (Lidji 2018). The distance to infrastructure means that a large investment would be required to develop. The pool also extends offshore underneath the Beaufort Sea, but no development plans have been announced for either onshore or offshore development. Caelus Energy has ceased Alaska operations but could transfer its lease to another operator.

Operators have expressed interest in conducting exploration and potential development in the Teshekpuk Lake area, which is currently closed to development. Very little exploration has occurred in this area due to the closures, but it is suspected to contain oil resources, especially in the area south of the lake. This location would be attractive for leasing due to the ability to tie into infrastructure at the nearby Alpine or Willow developments relatively easily.

The entire Alaska North Slope, including the project area, has sizeable known and projected natural gas reserves. Currently, no infrastructure exists to transport gas to market. Two gas pipelines are currently in the planning process to connect Prudhoe Bay to an export terminal and regional markets in southern Alaska. The USGS estimated that there is 6.9 trillion cubic feet of associated recoverable gas and 17.5 trillion cubic feet of non-associated recoverable gas associated with the Nanushuk and Torok Formations (Houseknecht et al. 2017). Total non-associated gas reserves in the project area are estimated to be approximately 52.8 trillion cubic feet (Houseknecht et al. 2010). Given the pipeline daily capacity and the volume of recoverable gas surrounding the initial pipeline connections in Prudhoe Bay, it is not likely that gas resources in the planning area would be developed during the life of this EIS. Prior to gas pipeline connection, any associated gas produced during oil production in the planning area would be re-injected back into the formation in order to maintain reservoir pressure.

Small-scale development of natural gas or coalbed methane to supply heat and power to native villages is possible; however, development of this type is costly and has not yet occurred anywhere in the planning area.

Climate Change

Climate change will not affect the existence or location of petroleum resources. Techniques for accessing and extracting those resources would have to take into consideration exploration and development in a changing climate. Oil and gas development in Alaska, particularly in the northern latitudes, involves the use of ice roads, snow trails, and ice pads for transportation of equipment and supplies, usually during the exploration and development phases. A warming climate could result in a shorter ice road season and reduced permafrost stability.

Trends

Petroleum resource leasing and development is expected to continue to occur in the planning area for the foreseeable future. Changes in the rate or intensity of development depend on market forces and other complex factors. See **Appendix B**, **Sections B.3** and **B.4** for projections of petroleum resource development activity in the planning area.

Direct and Indirect Impacts

The issuance of petroleum leases and the foreseeable subsequent development of petroleum resources would continue to result in the development of petroleum resources under all alternatives. Under all alternatives, existing leases would remain valid, and existing developments would continue to operate. The effects of climate change described in the *Affected Environment*, above, could influence the rate or degree of the potential direct and indirect impacts.

The effects of climate change described under the *Affected Environment*, above, are part of the baseline conditions for petroleum resources in the project area. See **Section 3.2.1** for a detailed discussion of the alternatives' contributions to global climate change.

Alternative A

Under this alternative, current leasing closures and stipulations would remain. Approximately 2,065,000 acres of high development potential area would be available for oil and gas leasing. Based on spill rates of current North Slope developments, it is estimated that under this alternative approximately 7,333 barrels' worth of oil could be spilled during the life of production (**Appendix I**, **Table I-1**). This would be a loss of petroleum resources from productive use. A gas blowout of a well during drilling or production is unlikely to occur; however, a typical case would result in the loss of approximately 10 million cubic feet of natural gas. A gas release from a gas pipeline or processing facility is also unlikely to occur, but it is estimated that it would result in the release of approximately 20 million cubic feet of natural gas. These incidents would represent a loss of petroleum resources.

Alternative B

Approximately 1,856,000 acres of high development potential area would be available for leasing. This would be an approximately 10 percent reduction in acres available for leasing compared with Alternative A. Based on spill rates of current North Slope developments, it is estimated that under this alternative approximately 6,584 barrels' worth of oil could be spilled during the life of production (**Appendix I**, **Table I-1**). This would be a loss of petroleum resources from productive use. A gas blowout of a well during drilling or production is unlikely to occur; however, a typical case would result in the loss of approximately 10 million cubic feet of natural gas. A gas release from a gas pipeline or processing facility is also unlikely to occur, but it is estimated that it would result in the release of approximately 20 million cubic feet of natural gas. These incidents would represent a loss of petroleum resources.

Alternative C

Approximately 2,606,000 acres of high development potential area would be available for leasing. This would be an approximately 21 percent increase in acres available for leasing compared with Alternative A. Based on spill rates of current North Slope developments, it is estimated that under this alternative approximately 9,230 barrels' worth of oil could be spilled during the life of production (**Appendix I**, **Table I-1**). This would be a loss of petroleum resources from productive use. A gas blowout of a well during drilling or production is unlikely to occur; however, a typical case would result in the loss of approximately 10 million cubic feet of natural gas. A gas release from a gas pipeline or processing facility is also unlikely to occur, but it is estimated that it would result in the release of approximately 20 million cubic feet of natural gas. These incidents would represent a loss of petroleum resources.

Alternative D

Approximately 3,581,000 acres of high development potential area would be available for leasing. This would be an approximately 43 percent increase in the number of acres available for leasing compared with Alternative A. Based on spill rates of current North Slope developments, it is estimated that under this alternative approximately 12,667 barrels' worth of oil could be spilled during the life of production (**Appendix I**, **Table I-1**). This would be a loss of petroleum resources from productive use. A gas blowout of a well during drilling or production is unlikely to occur; however, a typical case would result in the loss of approximately 10 million cubic feet of natural gas. A gas release from a gas pipeline or processing facility is also unlikely to occur, but it is estimated that it would result in the release of approximately 20 million cubic feet of natural gas. These incidents would represent a loss of petroleum resources.

Cumulative Impacts

The effects of climate change described under the *Affected Environment*, above, could influence the rate or degree of the potential cumulative impacts.

The primary past, present, and reasonably foreseeable future effects on petroleum resources are the depletion of those resources due to oil and gas production. The impacts of the IAP/EIS, when combined with past, present, and RFFAs, would contribute to cumulative impacts on petroleum resources in the area. The cumulative impacts area is the project area. The cumulative impacts on petroleum resources in the area would be probable and long term.

3.2.8 Paleontological Resources

Affected Environment

Paleontological resources include any physical evidence of past life, including fossilized flora and fauna, imprints, and traces of plants and animals. Sedimentary rocks that are typical of petroleum-producing formations underlay most of the NPR-A. As a result, the bedrock formations of the NRP-A contain a wide array of plant and animal fossils. Most of the limestone, sandstone, siltstone, conglomerate, and shale that underlay the NPR-A are marine in origin, which the fossils reflect. The first evidence of terrestrial plant fossils date to roughly 160 million years ago in the middle part of the Jurassic period, indicating at least a temporary retreat of the ancient seas that had previously covered most of the region. Following this period, the seas repeatedly advanced and retreated over most or all of the NPR-A.

For a more detailed description of the paleontological resources and paleontological research in the NPR-A, refer to Section 3.2.7 of the 2012 NPR-A Final IAP/EIS (BLM 2012).The BLM manages fossils to promote their use in research, education, and recreation, in accordance with the Paleontological Resources Preservation Act, Subtitle D of the Omnibus Public Land Management Act of 2009 (16 USC 470aaa through 470aaa-11), and the general guidance of Federal Land Policy and Management Act of 1976 and NEPA. Scientifically significant fossils, as defined in BLM Manual 8270 (BLM 1998a) and BLM Handbook H-8270-1 (BLM 1998b), are vertebrate fossils and their traces, as well as uncommon invertebrate and plant fossils.

The Potential Fossil Yield Classification (PFYC) system is a tool used to assess potential occurrences of paleontological resources in mapped geologic units. It provides classifications that may be used to assist in determining the need for further assessment or actions. The PFYC system is created from available geologic maps and assigns a class value to each geological unit, representing the potential abundance and significance of paleontological resources that may occur. PFYC values range from Class 1, Very Low, to Class 5, Very High. These values indicate both the probability for the mapped geologic unit to contain significant paleontological resources if bedrock is exposed and the degree of management concern for the resource. Class 4 (High) geologic units are known to contain a high occurrence of paleontological resources. Class 5 (Very High) are highly fossiliferous geologic units that consistently and predictably produce significant paleontological resources. PFYC assignments should be considered as only a first indication of the potential presence of paleontological resources and to focus further on inventory and ground surveys. Geologic units without enough information associated with them to assign a PFYC value may be assigned Class U, Unknown Potential (BLM 2016).

The PFYC model for Alaska is in development, although preliminary PFYC values have been assigned to the mapped geologic units in the planning area, which is included in **Table 3-12.**[3] The BLM maintains these PFYC assignments and will update them as additional data are available. When complete, the PFYC model will provide more information on the overall potential for paleontological resources and will present it in a geospatial format. **Table 3-13** shows the acreage and distribution of the PFYC classes within the NPR-A.

Table 3-12
PFYC Values of Planning Area Geologic Bedrock Units

Geologic Unit	Geologic Age	PFYC Value
Prince Creek Formation	Lower Tertiary, Paleocene, to Upper Cretaceous, Campanian	5
Sagavanirktok Formation	Tertiary, Miocene to Paleocene	4
Seabee Formation and Hue Shale	Upper Cretaceous, Coniacian to Turonian	4
Hunt Fork Shale (Endicott Group)	Devonian	3
Kanayut Conglomerate and Noatak Sandstone, undivided (Endicott Group)	Lower Mississippian and Upper Devonian	3
Kayak Shale (Endicott Group)	Mississippian	3
Kuna Formation (Lisburne Group)	Mississippian	3
Lisburne Group, undivided	Carboniferous	3
Nasorak and Utukok Formations (Lisburne Group)	Mississippian	3
Noatak Sandstone (Endicott Group)	Upper Devonian	3
Nuka Formation	Carboniferous	3
Okpikruak and Kongakut Formations	Lower Cretaceous	3
Schrader Bluff Formation	Upper Cretaceous, Maastrichtian to Santonian	3
Tupik and Kogruk Formations (Lisburne Group)	Pennsylvanian to Upper Mississippian	3
Akmalik Chert and other black chert of the Lisburne Group	Mississippian	2
Unconsolidated and poorly consolidated surficial deposits	Quaternary, Pleistocene, and uppermost Tertiary	2
Mafic and ultramafic rocks in central, western, and northern Alaska	Jurassic to late Proterozoic	1
Bedrock of unknown type or age or areas not mapped	unknown	U
Nonmarine to shelf sedimentary rocks	Tertiary and Cretaceous	U
Sedimentary rocks of the North Slope	Cretaceous, Cenomanian to Albian	U

Sources: BLM GIS 2019; Breithaupt, B. BLM Regional Paleontologist, email to Kevin Doyle, EMPSi Environmental Planner, May 16, 2019, regarding preliminary PFYC rankings and unit descriptions for the planning area

Table 3-13
PFYC Values Within the NPR-A

Preliminary Classification	Acres (Rounded to the nearest 1000)
5	252,000
4	624,000
3	1,375,000
2	13,899,000
1	33,000
U	6,525,000

Source: BLM GIS 2019

The BLM does not currently have a comprehensive known fossil locality geodatabase, although the Alaska Heritage Resources Survey dataset includes some localities among the cultural resource data. The BLM does maintain confidential files and reports that reference fossil localities. In addition, Native Alaskan art, spiritual, and utilitarian objects are sometimes made from fossilized walrus ivory and mammoth and other mammal bones. Excavating for fossils is not permitted on public lands except for scientific purposes, although fossil localities are likely known to community members. The following is an example of documented traditional knowledge of fossil localities.

> *Also like to view into the realm of paleontology, and emphasize an area I think it's around Ocean Point on the Colville, where there's a large paleontological site that has been investigated for many years by paleontologists from UAF. I just wanted to point that out as an important area* (Nuiqsut) (BLM 1997b).
>
> *The Colville River region is very well known for that. We will happen by the tusks. Ivory, bones. I am quite sure that it is over there* (Nuiqsut) (SRB&A Unpublished-b).

Climate Change

Changing climate conditions would not directly affect paleontological resources but could affect several geologic hazards, including thawing permafrost and coastal erosion. An increase in the active layer expected from a warming climate could result in greater areas of land subsidence and melting, which may expose geologic units with paleontological resources to weathering action. Similarly, erosion also would expose previously protected units to weathering and make them more visible and susceptible to unauthorized collection. Given the surficial context of these deposits, the geologic unit with the greatest risk is the unconsolidated and poorly consolidated surficial Quaternary deposits, which may contain Pleistocene fossils.

Direct and Indirect Impacts

Impacts Common to All Alternatives

Issuance of oil and gas leases would have no direct impacts on the environment because, by itself, a lease does not authorize any on-the-ground oil and gas activities; however, a lease does grant the lessee certain rights to drill for and extract oil and gas subject to further environmental review and reasonable regulation, including applicable laws, terms, conditions, and stipulations of the lease. The impacts of such future exploration and development activities that may occur because of the issuance of leases are considered potential indirect impacts of leasing. Such post-lease activities could include seismic and drilling exploration, development, and transportation of oil and gas in and from the NPR-A; therefore, the analysis in this section is of potential direct, indirect, and cumulative impacts from on-the-ground post-lease activities. This IAP/EIS also analyzes direct, indirect, and cumulative impacts of similar oil and gas activities that may not be associated with an active lease, such as seismic surveys of unleased areas and pipelines transporting oil and gas from offshore leases.

All alternatives allow for infrastructure construction to support oil and gas exploration, development, and transport. When not routed away from paleontological resources, ground-disturbing activities can cause the most direct and severe impacts on such resources by physically damaging or destroying all or part of a paleontological resource, removal of a fossil from its original location, or disturbing the stratigraphic contexts in which fossils are located. Examples of expected ground-disturbing activities include material site (e.g., sand and gravel) excavation and extraction; gravel road, pad, airstrip, bridge, and culvert construction and maintenance; construction of vertical support members for power lines and pipelines; and any other disturbance of the ground surface in the proximity of development project components.

Certain future impacts, such as oil spills, can also contaminate organic remains to make them undatable. New infrastructure development in the NPR-A could also indirectly impact paleontological resources. Increased accessibility could allow new opportunities for fossil looting or vandalism by personnel and visitors. The effects of climate change described in the *Affected Environment*, above, could influence the rate or degree of erosion, permafrost thaw, and thermokarsting, and with it, the potential for direct and indirect impacts. Erosion resulting from development can also result in new discoveries of paleontological resources; while there is a risk for direct damage to scientifically important resources caused by development, there is also an opportunity for new discoveries and public interpretation.

Erosion along river corridors exposes fossils, which increases the likelihood of damage or unauthorized collection. Managing rivers suitable for Wild and Scenic Rivers designation and designating buffers around major rivers would limit permanent development and provide incidental protection of paleontological resources along these corridors. Sand and gravel mining are permitted throughout the planning area; however, sand and gravel extraction is ground disturbing and could potentially disturb Pleistocene fossils and their contexts. ROP E-13 would require paleontological surveys prior to excavating for sand and gravel extraction. Activities or allocations that would allow or restrict ground disturbance, increase or decrease accessibility and exposure of resources, increase or decrease erosion, and implement stipulations and ROPs would affect the relative potential for impacts on paleontological resources. ROP E-13 states that oil and gas lessees will conduct a paleontological resources survey prior to engaging in any potential ground-disturbing activity. ROP E-13 also requires notification in the case of any unanticipated discoveries and suspension of all operations in the immediate area of such discovery until written authorization to proceed.

Additional protection is provided by ROP C-2, which affords protection to streambanks and minimizes soil compaction and impacts on the surface and near-surface of the landscape. Also contributing to the protection of paleontological resources is ROP I-1, which requires that all personnel involved in oil and gas-related activities be made aware of environmental concerns that relate to the region/work site. Additional protection that applies in some select biologically sensitive areas also provides incidental protection for paleontological resources in flood plains, terraces, and banks of specific rivers. The inventorying and monitoring conducted in the NPR-A by the BLM, other agencies, and permittees over the last two decades contribute to this protection. For a more detailed description of the potential impacts on paleontological resources in the NPR-A, refer to Section 4.3.2 of the 2012 NPR-A Final IAP/EIS (BLM 2012).

The effects of climate change described under the *Affected Environment*, above, are part of the baseline conditions for paleontological resources in the project area. See **Section 3.2.1** for a detailed discussion of the alternatives' contributions to global climate change.

Alternative A

Under Alternative A, the types of potential impacts on paleontological resources would be the same as those described above in *Impacts Common to All Alternatives*. These are also described in Section 4.5.2 of the 2012 NPR-A Final IAP/EIS (BLM 2012) for Alternative B-2, which was the preferred alternative chosen in the 2013 NPR-A IAP ROD. The BLM concluded that other than Pleistocene remains, most vertebrate paleontological material is deeply buried and is, therefore, not regularly encountered by chance.

The drilling of exploration and delineation wells would occur during winter, and these activities could potentially have an impact on paleontological resources. The most intense impact on paleontological resources from BLM management activities would most likely result from gravel excavation to construct permanent facilities; however, surveys for paleontological resources must be conducted before excavation or any potential ground-disturbing activities could take place. Paleontological resource protection measures, along with the wide distribution and low density of these resources throughout the NPR-A, would help maintain a low probability of oil-related and non-oil-related activities negatively affecting paleontological resources.

This analysis uses geologic units that are known to contain high or very high occurrences of paleontological resources (PFYC 4 and PFYC 5, respectively) to evaluate the impacts under the different alternatives. **Table 3-14** quantifies acres of PFYC 4 and PFYC 5 geologic units on which oil and gas leasing would be closed, restricted, or open, while **The presence** of PFYC 4 or 5 units does not necessarily predict exposures of significant fossil localities, or the likelihood of actions at a depth or intensity that would affect the resource. Fossils may also occur in areas that may have less sensitive or unknown PFYC units, and the classifications may not highlight potential fossil-bearing alluvium or locations where young alluvial deposits or deep soils may cover and obscure sedimentary bedrock. It should be noted that identified PFYC 4 and 5 units total 876,000 acres out of a planning area of over 22 million acres, and these bedrock units generally do not have large surface exposures.

Table 3-15 quantifies acres of PFYC 4 and PFYC 5 geologic units available to new infrastructure. These allocations indicate the potential for impacts, but do not demonstrate a known impact or that all acres would be subject to actions that may affect paleontological resources. These data serve as a guide to evaluate the need for further investigation when authorizing future actions, and to broadly compare the relative risk of impacts among alternatives. The BLM also has additional location-specific information based on years of past inventory and monitoring.

Table 3-14
Acres of Potential Disturbance to PFYC 4–5 Units — Fluid Minerals

Alternative	PFYC Class	Open - Standard Terms and Conditions	Open - ROP	Open - NSO	Closed to Fluid Mineral Leasing
A	Total PFYC 5 Acres	30,000	62,000	161,000	0
	Total PFYC 4 Acres	428,000	118,000	60,000	17,000
B	Total PFYC 5 Acres	36,000	0	216,000	0
	Total PFYC 4 Acres	479,000	0	51,000	17,000
C	Total PFYC 5 Acres	77,000	0	175,000	0
	Total PFYC 4 Acres	562,000	0	62,000	0
D	Total PFYC 5 Acres	77,000	0	175,000	0
	Total PFYC 4 Acres	562,000	0	62,000	0

Source: BLM GIS 2019
ROP = required operating procedure
NSO = no surface occupancy

The presence of PFYC 4 or 5 units does not necessarily predict exposures of significant fossil localities, or the likelihood of actions at a depth or intensity that would affect the resource. Fossils may also occur in areas that may have less sensitive or unknown PFYC units, and the classifications may not highlight potential fossil-bearing alluvium or locations where young alluvial deposits or deep soils may cover and obscure sedimentary bedrock. It should be noted that identified PFYC 4 and 5 units total 876,000 acres out of a planning area of over 22 million acres, and these bedrock units generally do not have large surface exposures.

Table 3-15
Acres of Potential Disturbance to PFYC 4–5 Units — New Infrastructure

Alternative	PFYC Class	Available for New Infrastructure	Unavailable with Exceptions	Unavailable for New Infrastructure
A	Total PFYC 5 Acres	91,000	161,000	0
	Total PFYC 4 Acres	546,000	60,000	17,000
B	Total PFYC 5 Acres	36,000	216,000	0
	Total PFYC 4 Acres	479,000	127,000	17,000
C	Total PFYC 5 Acres	77,000	175,000	0
	Total PFYC 4 Acres	562,000	62,000	0
D	Total PFYC 5 Acres	77,000	175,000	0
	Total PFYC 4 Acres	562,000	62,000	0

Source: BLM GIS 2019

Overall under Alternative A, approximately 52 percent (11.8 million acres) of the NPR-A's subsurface lands would continue to be available for oil and gas leasing with different areas subject to standard terms and conditions or NSO stipulations. For identified PFYC 4 and PFYC 5 units, 772,000 acres would continue to remain open with different levels of restrictions; 17,000 acres would be closed, and 167,000 acres would have NSO restrictions (**Table 3-14**). Closure and NSO provisions provide the least risk of impacts on paleontological resources while still providing opportunities for oil and gas development.

Areas available for constructing new infrastructure would include 91,000 acres in PFYC 5 and 546,000 acres in PFYC 4. Areas that would be unavailable for new infrastructure "with exceptions" include 161,000 acres in PFYC 5 and 60,000 acres in PFYC 4. No acres in PFYC 5 and 17,000 acres in PFYC 4 would continue to be unavailable for new infrastructure construction (see **The presence** of PFYC 4 or 5 units does not necessarily predict exposures of significant fossil localities, or the likelihood of actions at a depth or intensity that would affect the resource. Fossils may also occur in areas that may have less sensitive or unknown PFYC units, and the classifications may not highlight potential fossil-bearing alluvium or locations where young alluvial deposits or deep soils may cover and obscure sedimentary bedrock. It should be noted that identified PFYC 4 and 5 units total 876,000 acres out of a planning area of over 22 million acres, and these bedrock units generally do not have large surface exposures.

Table 3-15). New construction and other ground-disturbing activities would continue to be subject to further review. With the application of the referenced ROPs and implementation of protection measures for other resource values, activities within the NPR-A would continue to have a low probability of affecting paleontological resources.

Impacts Common to All Action Alternatives

All the action alternatives include the potential for construction of additional community infrastructure, roads, and utility projects with appropriate mitigation measures in areas closed to oil and gas leasing. The potential for impacts would be the same as described above in *Impacts Common to All Alternatives.* These authorized and mitigated activities within the NPR-A would have a low probability of affecting paleontological resources.

Alternative B

The potential impacts on paleontological resources from leasing and subsequent oil and gas exploration, development, and production under Alternative B would be similar to those identified above under *Impacts Common to All Alternatives* and Alternative A. When compared with Alternative A, Alternative B would include 55,000 more acres in PFYC 5 areas with NSO restrictions and that also would be unavailable "with exceptions" for infrastructure construction. Like Alternative A, 17,000 acres in PFYC 4 under Alternative B would remain closed to mineral leasing and also unavailable for new infrastructure construction (see **Table 3-14** and **The presence** of PFYC 4 or 5 units does not necessarily predict exposures of significant fossil localities, or the likelihood of actions at a depth or intensity that would affect the resource. Fossils may also occur in areas that may have less sensitive or unknown PFYC units, and the classifications may not highlight potential fossil-bearing alluvium or locations where young alluvial deposits or deep soils may cover and obscure sedimentary bedrock. It should be noted that identified PFYC 4 and 5 units total 876,000 acres out of a planning area of over 22 million acres, and these bedrock units generally do not have large surface exposures.

Table 3-15).

Twelve rivers would be recommended for Wild and Scenic River designation under Alternative B, providing additional incidental protections for river terraces and corridors, which may include surficial paleontological resources. Potential pipeline corridors would be subject to a site-specific NEPA analysis, including consideration of impacts on paleontological resources. With the application of ROPs and stipulations, the potential impacts on paleontological resources would be less than under Alternative A, and there would continue to be a low probability of affecting paleontological resources.

Alternative C

The potential impacts on paleontological resources from leasing and subsequent oil and gas exploration, development, and production under Alternative C would be similar to those identified above under *Impacts Common to All Alternatives* and Alternative A. When compared with Alternative A, Alternative C would increase the overall numbers of acres available for potential leasing and development and infrastructure to approximately 17 million acres. For identified PFYC 4 and PFYC 5 units, 877,000 acres would be open with different levels of restrictions. Compared with Alternative A, Alternative C would include 14,000 more acres in PFYC 5 areas with NSO restrictions and that would also be unavailable "with exceptions" for infrastructure construction. No acres in PFYC 4 or PFYC 5 would be closed to fluid mineral leasing (see **Table 3-14** and **The presence** of PFYC 4 or 5 units does not necessarily predict exposures of significant fossil localities, or the likelihood of actions at a depth or intensity that would affect the resource. Fossils may also occur in areas that may have less sensitive or unknown PFYC units, and the classifications may not highlight potential fossil-bearing alluvium or locations where young alluvial deposits or deep soils may cover and obscure sedimentary bedrock. It should be noted that identified PFYC 4 and 5 units total 876,000 acres out of a planning area of over 22 million acres, and these bedrock units generally do not have large surface exposures.

Table 3-15).

Alternative C would not designate 12 rivers for the Wild and Scenic Rivers System, but it would manage them to protect similar values, which would provide additional incidental protections for surficial paleontological resources that may be present in river terraces and corridors. Potential pipeline corridors would be subject to a site-specific NEPA analysis, including consideration of impacts on paleontological resources. With the application of stipulations and ROPs, the potential impacts on paleontological resources may be more than under Alternative A, but there would continue to be a low probability of affecting paleontological resources.

Alternative D

The potential impacts on paleontological resources from leasing and subsequent oil and gas exploration, development, and production under Alternative D would be similar to those identified above under *Impacts Common to All Alternatives* and Alternative A. Compared with Alternative A, Alternative D would increase the overall numbers of acres available for potential leasing and development and infrastructure to approximately 18.3 million acres. For identified PFYC 4 and PFYC 5 units, 877,000 acres would be open with different levels of restrictions. When compared with Alternative A, Alternative C would include 14,000 more acres in PFYC 5 areas with NSO restrictions and that would also be unavailable "with exceptions" for infrastructure construction. No acres in identified PFYC 4 or PFYC 5 units would be closed to fluid mineral leasing (see **Table 3-14** and **The presence** of PFYC 4 or 5 units does not necessarily predict exposures of significant fossil localities, or the likelihood of actions at a depth or intensity that would affect the resource. Fossils may also occur in areas that may have less sensitive or unknown PFYC units, and the classifications may not highlight potential fossil-bearing alluvium or locations where young alluvial deposits or deep soils may cover and obscure sedimentary bedrock. It should be noted that identified PFYC 4 and 5 units total 876,000 acres out of a planning area of over 22 million acres, and these bedrock units generally do not have large surface exposures.

Table 3-15).

Alternative D would not designate 12 rivers for the Wild and Scenic Rivers System, but it would manage them to protect similar values, which would provide additional incidental protections for surficial paleontological resources that may occur in river terraces and corridors. Pipeline corridors are not specified under Alternative D, but any infrastructure projects would be subject to a site-specific NEPA analysis, including consideration of impacts on paleontological resources. With the application of stipulations and ROPs, the potential impacts on paleontological resources may be more than under Alternative A, but there would continue to be a low probability of affecting paleontological resources.

Cumulative Impacts

The cumulative impact area for paleontological resources is the program area, the North Slope of Alaska, and the near-shore marine environment. The time frame for the cumulative impacts analysis spans from the 1970s through full realization of the hypothetical development scenario, which is anticipated to occur approximately 70 years after the ROD for this EIS is signed. Projecting RFFAs so far in the future is highly speculative.

Past activities and projects have affected paleontological resources primarily from stratigraphic disturbance, destruction, or unauthorized collection. Present and reasonably foreseeable trends and projects may contribute to cumulative impacts. Future projects and actions relevant to the cumulative impact analysis are described in **Appendix F**, **Table F-1**. Impact discussions focus on impacts on vertebrate fossils (animals with a backbone) rather than the remains of marine plant and invertebrates that are numerous and not threatened from stratigraphic disturbance, destruction, or unauthorized collection.

Much of the planning area has not been subject to activities at the depths or intensity that may affect paleontological resources in bedrock. Most vulnerable are Pleistocene-age remains, which are most often present in surface and near-surface deposits. This is the context where paleontological resources are most susceptible to impacts from the activities that have occurred and are likely to continue to occur in the NPR-A. Impacts are associated with past, present, and future activities from oil and gas, energy, village, utility, military, transportation, and infrastructure development; gravel and other material extraction; recreation; scientific research; unauthorized collection; and natural processes exacerbated by climate change. Past adverse impacts were primarily the result of limited regulations governing ground-disturbing activities and the low level of awareness and concern regarding the potential adverse impacts on paleontological resources.

Past ground-disturbing activities associated with oil and gas exploration and development include early seismic work, construction of supporting infrastructure, facility footprints, and the methods and equipment used to transport material across the landscape. These activities and practices caused more surface disturbance than those used today. The excavation of gravel to construct roads, pads, and other facilities has resulted in impacts on paleontological resources. Most mammalian fossils are of Pleistocene age, which also is the age and origin of most North Slope gravel sources. Therefore, the more gravel deposits that are excavated for development infrastructure, the greater possibility that impacts on paleontological resources will occur. Current practices reduce the need for gravel to construct permanent roads and pads. Reductions in the size of the facility footprint, as well as a slowing of oil development activities, have substantially reduced the potential for impacts.

Paleontological research and excavation are necessary for the recovery of scientific data and have contributed directly to the displacement of paleontological resources, as has unauthorized paleontological material collection related to recreational activities. As long as paleontological resources that have been removed in the past have been preserved in museums or other institutions and made available for study and interpretation, their losses should not be viewed as negatively cumulative.

Increased activities associated with oil and gas development will occur. The larger the area affected, the greater the possibility that vertebrate paleontological resources could be affected. In most cases other than Pleistocene- and some Tertiary-age paleontological resources, fossil materials are usually deeply buried and therefore protected from most oil and gas-related activities. Oil and gas, transportation, and village infrastructure will continue to be developed, increasing the potential for ground disturbance and impacts on paleontological resources.

Improved access to areas where paleontological resources may be present may lead to increased human activity (such as recreation), concentrated use of certain areas, and unauthorized collection, disturbance, or vandalism. The potential for paleontological resource impacts would increase as access and recreational use intensify and become more focused on certain areas.

The effects of climate change described under the *Affected Environment*, above, could influence the rate or degree of the potential cumulative impacts. The ongoing and future effects of climate change would expose previously protected units to weathering, damage, and possible unauthorized collection, especially in unconsolidated and poorly consolidated surficial Quaternary deposits, which may contain Pleistocene fossils (SNAP 2019). The potential effects of erosion and subsidence would be cumulatively greater when combined with anticipated ground disturbance. The thawing of permanently frozen ground could intensify riverbank and beach bluff erosion, which could affect known and undocumented paleontological vertebrate deposits. In addition, thawing permafrost would likely result in decreased preservation of subsurface materials, particularly in areas with sparse vegetation and little or no organic soil.

Climate change will also cause the alteration of weather patterns. An increase in the frequency and intensity of spring and fall storms is likely to occur with the potential to adversely affect near-shore paleontological deposits.

All the alternatives could contribute to cumulative effects on paleontological resources. In all cases, there would be further consideration of the impacts on paleontological resources for future site-specific actions. Contributing to these protections are the inventorying and monitoring that has been conducted in the NPR-A by the BLM, cooperators, and permittees both prior to and since leasing began. Carrying forward these and similar protections into the future should provide positive results in reducing cumulative adverse impacts on paleontological resources within the NPR-A. Alternative B would have the least potential for contributing to cumulative impacts, since it has the least land open to oil and gas development and the most NSO acres where PFYC 5 units are collocated. The BLM would expect the potential cumulative impact contributions to be greatest under Alternative D, followed by Alternative C, given that these alternatives would make the most land available to ground-disturbing activities.

3.2.9 Soil Resources

Affected Environment

Soils

Soil information presented in Section 3.2.8 of the 2012 IAP EIS (BLM 2012), and the associated map for the NPR-A area of analysis (**Map 3-3**), are based on the Exploratory Soil Survey of Alaska (Rieger et al. 1979). The exploratory survey of the NPR-A planning area and field mapping (done at a scale of 1:500,000 began in 1967 and was completed in 1973. Refer to the Exploratory Soil Survey of Alaska for an in-depth description of individual soils and soil associations.

The Exploratory Soil Survey of Alaska (Rieger et al. 1979) provides a general statewide map of soil resources of Alaska. This document is used in this discussion to describe the major soil resources in the NPR-A. Soils are classified and named based on soil taxonomy (USDA-NRCS 2014). Map units consist of a number of soil components that are named at the subgroup level in this classification system. There are nine map units in the NPR-A (**Map 3-3**), defined in Section 3.2.8 of the 2012 IAP EIS (BLM 2012). Since the Exploratory Soil Survey of Alaska was published, the U.S. Department of Agriculture soil taxonomy has undergone numerous changes with the 12th Edition of the Keys to Soil Taxonomy, published in 2014, the most current version available. The Natural Resources Conservation Service has provided an up-to-date list of subgroup names based on this version; however, map unit symbols, soil properties, and other information remains unchanged.

Integrated terrain unit mapping was performed by Wells et. al. (2018) in the Willow master development plan area to classify relationships between surficial geology, geomorphology, soils, vegetation, and disturbance regime. The soils in the analysis area are primarily divided into four geological deposit types: coastal, eolian, fluvial, and mountain colluvium and alluvium (Surficial Geology Map, SNAP 2018). Each of these deposit types yields varying permafrost and vegetation types, as well as material composition and landform characteristics. Jorgenson (2015) performed additional refinement of the surficial geology in the analysis area, based on ecological landscape classification. The maps further subdivide the subdivisions by soil type, such as eolian silts and eolian sands.

Permafrost

The study area lies within a continuous zone of permafrost, ranging from about 650 to 2,130 feet deep in the North Slope region (permafrost extents map, SNAP 2018). Due to the confining barrier that prevents infiltration of surface water, the active layer of soils may become saturated. This can create large wetlands in areas of little precipitation. The presence of thermokarst appears more as temperatures rise and more soil disturbance occurs.

The entire program area is underlain by permafrost with isolated areas of thaw near deep lakes, springs, and rivers (Bird and Magoon 1987). Depending on their depth and size, lakes and rivers influence the presence of permafrost; deeper lakes and rivers, such as Teshekpuk Lake, often form a thaw bulb below the waterbody (Rawlinson 1993). Permafrost and ground ice characteristics are variable, due to differences in climate, topography, soil properties, cryogenic processes, and environmental history (Jorgenson et al. 2015). Massive ice occurs in the form of ice wedges, buried glacial ice in glacial deposits, and intrusive ice (Jorgenson 2018). Permafrost in the Arctic Coastal Plain is generally between 650 and 2,130 feet thick (SNAP 2018). Polygonal patterned ground is created when ice wedges form in the upper few feet of the ground surface and is indicative of ice-rich soils. Polygonal ground is a common surface feature in the program area, especially in lowland areas; polygons may be less apparent in drained upland areas, where vegetation can mask these surface features (Rawlinson 1993).

The top layer of the soil surface that typically thaws and refreezes annually is known as the active layer. In the Arctic Coastal Plain, the active layer is generally between 1 and 4 feet thick (SNAP 2019). Active layer thickness can vary from year to year and depends on such factors as ambient air temperature, aspect, gradient, vegetation, drainage, snow cover, water content, and soil type. Siltier soils with thick organic mats (i.e., IQ6 and IQ2) tend to be ice rich, with thinner active layers, whereas soils in the foothills comprised of drift and alluvium (IQ8 and IQ21) tend to be less ice rich; they have thinner organic mats and thicker active layers. Long-term permafrost temperature monitoring shows a warming trend over the past 25 years, with the greatest warming near the coast (SNAP 2018).

Degradation of permafrost can be affected by ice content, soil or vegetation removal, and ground disturbances, with ice-rich and thaw-unstable soils and hillsides being the most sensitive to thawing (ADNR 2018). Thawing, ice-rich, permafrost soils create thermokarst features that transform the landscape by subsidence, erosion, and changes in drainages, including channelization and ponding (Jorgenson et al. 2015). Changes in the landforms due to erosion and thermokarst, such as slumping and channelization, affect the vegetation and water characteristics of the area (Jorgenson et al. 2015). Local residents have reported observations of changes in landforms due to thermokarsting and increased rates of melting permafrost due to water, especially at river banks and sedimentation within the river (Nuiqsuit, SRB&A Unpublished-b). The ice-rich eolian (windblown) silts of soil types IQ2 and IQ6, such as yedoma (ice-rich, eolian silt deposits), are more susceptible to thermokarst than more thaw-stable eolian sands and alluvial/fluvial deposits. Thaw strain measurements of coastal plain eolian silts indicate that settlement, due to frozen silt thawing, can be as much as 30 to 100 feet and is generally greater than thaw settlement of frozen eolian sand deposits (Pullman et al. 2007).

In the northern region of the NPR-A there are abundant areas of yedoma. These deposits can be over 130 feet thick, with large ice wedges that make up the whole sequence. It is thought that seismic exploration during the winter will decrease the likelihood of disturbance or complete degradation of yedoma, where there is a high potential of thawing of ice wedges (Jorgenson et al. 2015). Degradation of ice wedges in yedoma deposits and other ice-rich deposits caused by thermokarst and thermal erosion can result in extensive ecosystem changes, pose dangers to infrastructure, and be very difficult, if not impossible, to mitigate.

Climate Change

There are predictions that climate change will continue to warm and dry NPR-A from the historically recorded ranges. Warmer temperatures are not likely to accelerate the soil-forming processes significantly enough to measure the change during the period covered by this plan; this is because soil formation is a very slow process. As soils dry out, there is also a reduction in the chemical reactions that aid in soil formation. Climate change may affect the depth to permafrost in the soil profiles, as indicated by SNAP (2018). The top of the permafrost layer will likely recede below the surface very slowly, increasing the thickness of the active layer. This may allow the water table to drop below the surface of the soil. In some locations this may allow the water to drain out of the profile, because many of the soils are high in organic matter and low in mineral content. Subsidence is due to thermokarst, thawing, and movement and can create instability where soils thaw on slopes.

The vulnerability of permafrost to degradation depends on a complex interaction of surface changes and soil and permafrost characteristics (Jorgenson et al. 2015). Changes to soils and permafrost on the North Slope resulting from a changing climate are fully described by the BLM (2018). Changes include an increase of the active layer thickness and the potential for increased settlement due to thermokarst and ice wedge degradation as warming temperatures increase. Residents of communities within the NPR-A report that melting permafrost has created areas of deep water where the ground surface was once walkable but is not traversable or usable any longer. Melting permafrost is flooding and collapsing ice cellars and releasing methane, posing a danger to residents and a loss of usable ice cellar infrastructure (Anaktuvuk Pass, SRB&A Unpublished-a).

Wang et al. (2018) compiled data for numerous instrumented sites across the analysis area and the surrounding regions. The data collected at 72 stations on soil temperature, air temperature, and snow depth indicate that changes in near-surface ground temperatures over time are important indicators of changing climate. This is because they provide vital information on the response of the permafrost to climate change. Available climate data indicate warming trends across the Arctic coastal plain analysis area of soils at approximately 3 feet below the ground surface of about 0.15 degrees Celsius per year across the analysis areas (Wang et al. 2018; Urban and Clow2017).

Direct and Indirect Impacts

Non-oil and gas-associated activities that include overland travel and activities can alter the protective vegetation cover of soils and permafrost, causing damage and soil erosion or thawing of permafrost. Many activities, such as foot traffic or vehicular traffic, may result in minor impacts on a limited area; however, repeated travel over a single pathway or trail can lead to irreversible damage and thermokarsting. Impacts from these activities will be influenced by the location (saturated, fine-grained/organic soils in low-lying areas versus upland, dry granular soils), vegetation type, and activity type and frequency (e.g., repeated off-road vehicle travel versus a single aircraft landing).

Potential impacts from non-oil and gas-associated development include:

- Local activities associated with subsistence and off-road travel
- Local infrastructure construction (e.g., roads, airstrips, and pipelines)

- Recreation (camping, hiking, hunting, and off-road travel)
- Scientific activities and archaeological/paleontological digs
- Contaminated site cleanup

The impacts of future exploration and development activities that may occur because of the issuance of leases are considered potential indirect impacts of leasing. Such post-lease activities could include seismic and drilling exploration, development, transportation of oil and gas in the NPR-A, and abandonment. **Appendix B, Section B.3** identifies oil and gas actions that would likely occur. This analysis includes potential direct and indirect impacts on soil resources from on-the-ground post-lease activities, non-oil and gas activities, and oil and gas activities in unleased areas, such as seismic exploration and pipelines transporting oil from off-shore leases.

Potential impacts from the development and operation of oil and gas-associated facilities identified in the hypothetical development scenario (**Appendix B, Section B.5**) are as follows:

- Placement of gravel fill for pads, roads, and airstrips
- Construction of vertical support members for pipelines and building foundations
- Construction of ice roads and pads
- Removal of sand and gravel resources for embankment fills
- Impacts from exploratory seismic activities
- Abandonment and reclamation of sand and gravel pads, roads, and airstrips
- Deposition of dust away from facilities that may affect permafrost and vegetation

Exploration, development, production, and reclamation all involve vehicular travel on snow and ice-covered tundra. This changes and disturbs the insulating surface vegetation layer, thereby increasing the active layer thickness, thawing the permafrost, and developing thermokarst structures. Thermokarst changes the surface topography, increasing water accumulation, changing surface water drainage patterns, and increasing the potential for soil erosion and sedimentation (BLM 2018a; Jorgenson et al. 2010).

The effects of climate change described under *Affected Environment*, above, could influence the rate or degree of the potential direct and indirect impacts.

Impacts Common to All Alternatives

Under all alternatives, the potential for impact from non-oil and gas-related activities is present. Community-based activities, as described above (recreation, overland travel, and subsistence activities), and infrastructure projects would likely have the greatest impact with possible road projects to connect communities with the program area. These impacts will have similar impacts to those described below for overland travel and placement of gravel fills and the direct impacts on soil and permafrost resources.

Under all action alternatives, placing gravel fill and vertical support members for future construction of roads, pads, airstrips, pipelines, and structures could have direct impacts on soil quality and permafrost in and next to the gravel fill footprint. Changes to surface drainage due to the placement of fills causes permafrost thawing and subsidence and water accumulation. Placed fills would cover soils and kill vegetation, altering Spill Projections for the NPR-A IAP EIS layer (USACE 2018). Installing vertical support members for pipelines would displace and disturb soils around the vertical support member (BLM 2018a).

By changing drainage patterns of surface water, ponds and channels form and concentrate water that accelerates permafrost thaw. Where drainage patterns are altered, blockages can lead to ponding and sediment deposition. Where drainage patterns redirect surface flow or increase velocities, such as at embankments, sediments are eroded (BLM 2018a). Where water is cut off, it may result in the melting of ice wedges and the conversion from low centered polygons to high centered polygons, causing a major shift in ecosystems.

Potential indirect impacts on soil and permafrost in and next to the gravel fill footprints would be due to dust deposition and snow accumulation. Fugitive dust would be suspended in the air by vehicle and equipment use and would settle onto surrounding vegetation and snow, which would decrease surface albedo.[3] A decrease in surface albedo due to the presence of gravel pads and roads can increase absorption of solar radiation, accelerate the rate of snowmelt, and lead to permafrost thaw (USACE 2018). Dust accumulation can also affect the pH of the surrounding soils, which leads to changes in the health and growth of vegetation that holds soil in place. Dust mobilization can be reduced by implementing engineering controls, including limiting vehicle speeds and vegetation on bare soils (ROP G-2).

Blowing snow and drifting conditions, due to changes in topography from the construction of pads and roads and vertical support members/infrastructure foundations, change the thermal regime of the soils and permafrost next to the pad and road or vertical support members. Snow accumulation insulates the underlying soil during the winter, increasing the overall soil temperatures and leading to permafrost thaw at those locations, specifically the edge of the toe on road and pad embankments. Snow would accumulate more frequently on the leeward side of embankments (USACE 2018) or where snow fences are placed to increase snow accumulation for winter tundra travel (ROP C-2 and M-5).

Future sand and gravel material extraction and transport would be required to provide materials for embankment construction and would have impacts on the permafrost and soils in the mine site footprint, around its perimeter, and along transportation routes. **Section 3.2.10**, is a detailed discussion of the impacts of material extraction.

Future reclamation of roads and pads would be subject to the permitting process and must be developed in accordance with Lease Stipulation G-1. Removing gravel would affect the underlying soil and permafrost resources by exposing the underlying soils to increased solar radiation and lead to continued permafrost degradation (USACE 2018). Using separation fabrics and barriers can help reduce the loss of gravel into vegetation/soils and aid in removing gravel bases. Where gravel bases are removed, thermokarst greatly affects soil and vegetation rehabilitation; where ice-rich soils have thawed and formed deep lakes and troughs, intermingled with well-drained and high-centered polygons, ice-poor and well-drained soils may result in shallow thaw lakes or ponds (Pullman et al. 2007).

Ice road and pad construction and seismic survey impacts on soil and permafrost resources vary, depending on the type of vegetation, disturbance type, and depth of the active layer; however, the depth of thaw increases each year following ice road construction (Yokel et al. 2014). Seismic surveys and ice road/pad construction for resource exploration would be done during the winter to reduce impacts; however, vegetation would be affected, and the active layer would be disturbed; this would result in direct impacts on the soil quality and permafrost where seismic survey activities occur (Jorgenson et al. 2010).

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[4] The light that is reflected from the surface.

ROPs C-2 and L-1 (**Chapter 2, Table 2-2**) outline the protection and mitigation measures to be used to minimize impacts on soils and permafrost from off-road tundra travel, seismic exploration, and placement of gravel fill. These measures include seasonal off-road travel, vehicle specifications, protection and mitigation for multi-season routes, and ice road and pad construction.

Although there are no longer impacts from invasive seismic practices, thermokarst and thermal erosion from old seismic activities continue, observed in long-term studies of the 1984–85 2D-seismic survey in the 1002 Area. While less damaging, vehicle tracks from 3D-seismic surveys can initiate similar processes, due to the impacts on the ground surface topography and soil thermal regime, even without changes in air temperature and precipitation. The ground compaction by seismic vehicles, combined with the projected increases in temperatures and precipitation for the region, increase the risks for long-term hydrological impacts and widespread destabilization of ice-rich permafrost terrain (Walker et al. 2019). Thaw settlement can occur even at moderate levels of disturbance, damage can increase gradually over long periods, stabilization may take decades, and the depressions formed due to the upper permafrost degradation may persist for centuries (Walker 2019).

The effects of climate change described under *Affected Environment*, above, could influence the rate or degree of the potential cumulative impacts. The effects of climate change described under the *Affected Environment*, above, are part of the baseline conditions for soil resources in the project area. See **Section 3.2.1** for a detailed discussion of the alternatives' contributions to global climate change.

Alternative A

Under Alternative A, current management actions would be maintained, as described in the 2012 IAP Section 2.3 and current RFD. Additional activities associated with community infrastructure projects, scientific and agency research, seismic surveys in unleased areas, and recreational and subsistence activities would continue to occur throughout the NPR-A. This includes 11,763,000 acres of land that would be made available for fluid mineral leasing, with 10,815,000 acres open for development of infrastructure related to oil and gas leases. Approximately 2,065,000 acres would be made available in areas of high development potential and an additional 236 acres of disturbance for required material source needs. For ice-rich silty soils (IQ2 and IQ6) that are susceptible to thermokarsting, approximately 1,621,000 acres of land could be made available for development in the high development potential area. Greater quantities of yedoma are in the medium and low development potential areas.

Alternative B

Under Alternative B, 11,420,000 acres of land would be made available for fluid mineral leasing, with 8,283,000 acres open for development of infrastructure and pipelines related to oil and gas leases. Approximately 1,856,000 acres of Alternative B are in areas of high development potential. For ice-rich silty soils (IQ2 and IQ6) that are susceptible to thermokarsting, approximately 1,364,000 acres could be made available for development in the high development potential area. This is less acreage than under Alternative A. The maximum anticipated gravel needs would result in an additional 212 acres of disturbance under Alternative B. There are greater quantities of yedoma in the medium and low development potential areas. The reduction in acres available for leasing reduces the required number of gravel fill pads/roads/airstrips, but it may increase the miles of seasonal ice roads/pads and construction of vertical support members for pipelines. Non-oil and gas leasing activities as described under Alternative A would continue to occur under Alternative B. The impacts of these non-oil and gas leasing activities are described above under *Impacts Common to All Alternatives.*

Alternative C

Under Alternative C, 17,053,000 acres of land would be made available for fluid mineral leasing, with 13,541,000 acres open for development of infrastructure and pipelines related to oil and gas leases. Approximately 2,606,000 acres of Alternative C would be made available in areas of high development potential. For ice-rich silty soils (IQ2 and IQ6) that are susceptible to thermokarsting, approximately 1,800,000 acres of land could be made available for development in the high development potential area, a greater quantity of acreage than under Alternatives A and B. The maximum anticipated gravel needs would result in an additional 297 acres of disturbance under Alternative C. There are greater quantities of yedoma in the medium and low development potential areas. Non-oil and gas leasing activities as described under Alternative A would continue to occur under Alternative C. The impacts of these non-oil and gas leasing activities are described above under *Impacts Common to All Alternatives.*

Alternative D

Under Alternative D, 18,324,000 acres of land would be made available for fluid mineral leasing, with 13,930,000 acres open for development of infrastructure and pipelines related to oil and gas leases. Approximately 3,581,000 acres would be made available in areas of high development potential. For ice-rich silty soils (IQ2 and IQ6) that are susceptible to thermokarsting, approximately 2,553,000 acres of land could be made available for development in the high development potential area. An additional 409 acres of disturbance would be required for gravel mine disturbance; these quantities are higher than under the other three alternatives. There are greater quantities of yedoma in the medium and low development potential areas. Non-oil and gas leasing activities as described under Alternative A would continue to occur under Alternative D. The impacts of these non-oil and gas leasing activities are described above under *Impacts Common to All Alternatives.*

Cumulative Impacts

The general temporal and geographic scope for the analysis of cumulative effects is from the 1970s through 70 years after the ROD signing and across the North Slope of Alaska and the near-shore marine environment (**Appendix F**, **Section F.3.1**). Cumulative impacts on soil and permafrost resources in the NPR-A would occur from past and current exploration and development and from reasonably foreseeable future development. Past development and activities involved exploration and development for military and community infrastructure and overland travel. The 2012 IAP outlines past development, and the RFD outlines the existing and probable upcoming developments and infrastructure (**Appendix B**, **Section B.3**).

Each of the hypothetical development scenarios could affect over 8 million acres of soils and permafrost; however, the potential developable lease area under Alternative B is limited to just under 8 million acres, less than under the other alternatives. The potential impacts are related to future changes to topography and landforms changing soil chemical composition, drainage patterns, and erosion. Disturbance to surface vegetation directly leads to changes in the thermal regime of soils, due to the placement of gravel fill for pads and roads. This disturbance will last beyond the anticipated 80-year time frame of projects and the temporal scope of 70 years beyond the ROD signing, as the direct and indirect impacts on soils and permafrost can be indefinite.

The effects of climate change described under *Affected Environment*, above, could influence the rate, degree, and extent of the potential cumulative impacts. The total future direct and indirect impacts would be a sum of the impacts of gravel roads/pads/airstrips, seismic exploration, annual ice road construction, construction of pipelines, and non-oil and gas activities, including community infrastructure projects. As development progresses with future projects, the footprint for these developments may share infrastructure, which can reduce the cumulative impact; if stand-alone infrastructure is developed, the impact would increase accordingly. Impacts may also be made worse by proximity to other projects.

3.2.10 Sand and Gravel Resources

Affected Environment

The surface materials of the NPR-A Arctic Coastal Plain include upland silts, thaw lake deposits, alluvium and fluvial-lacustrine deposits, and eolian sands, derived from the local sandstones, limestones, and shales. Similarly, the surficial deposits of the Arctic Foothills Province are composed of eolian sand and upland silts and an undifferentiated bedrock of sandstones, shales, and conglomerates. Eolian sand and upland silts are the most widespread unconsolidated sediments in the entire NPR-A. These sand and silt deposits may be ice-rich and not suitable for foundations when thawed. Coarser grained alluvium (including gravel) is found along the river systems in southern portions of the NPR-A. **Appendix A**, **Map 3-4** shows the surficial geology of the NPR-A (Beikman 1980).

Currently, the only existing or previously utilized sand and gravel sites within the NPR-A are located around the villages. ConocoPhillips has identified an additional material site from the new Tiŋmiaqsiuġvik mine site west of the Colville River for use in development and construction of infield pads and roads for the Willow project (BLM 2019). The State of Alaska Department of Geophysical and Geological Surveys plans to conduct a study of sand and gravel resources within the coastal plain portion of the NPR-A in the 2019 and 2020 field seasons (Masterman 2019). The study will use Terrain Unit Mapping and review of existing information from historical seismic shot holes at the Alaska Geological Materials Center. Field surveys consisting of drilling 50-foot to 60-foot test holes and shallow hand auger borings at selected sites near Inigok and Teshekpuk Lake have been completed, and additional data collection is planned near the western portion of the NPR-A. No available reports for these studies are yet available. Additional data for offshore sand and gravel resources are proposed for the 2020 fiscal year (Masterman 2019).

West and north of the Colville River within the NPR-A, the coastal areas are characterized by an apparent scarcity of suitable construction materials. The southern portion of the NPR-A contains more abundant sand and gravel resources. The source of these sediments is the Brooks Range, from which the wind- and water-transported materials were originally eroded. The most suitable materials for NPR-A development would be found in the area's larger river systems; however, as one moves north away from the Brooks Range sediment sources, the materials become finer-grained and thus less suitable for use as construction materials.

As noted earlier, the vast majority of transported sediments on the North Slope are derived from soft sediment lithologies, such as sandstone, shale, and limestone, and as a consequence, produce poor quality construction materials. As a result, significant volumes would be required periodically for maintenance of any existing infrastructure. Where available, quartz-rich bedrock, such as quartzite, quartz-cemented conglomerate, and intrusive rocks (i.e., granite), represent a more durable and desirable gravel or crushed rock source (BLM 2012).

Climate Change

Climate change will not affect the existence or location of the mineral material deposits within the NPR-A. Techniques for accessing and extracting those resources would have to take into consideration mine development in a changing climate. Mining in Alaska, particularly in the northern latitudes, involves the use of ice roads, snow trails, and ice pads for transportation of equipment to and from the mineralized location, usually during the exploration and mine development phases. As the climate changes, the methods of mining and exploration might change as well. A warmer climate could lengthen the mining season while a cooler climate could shorten the mining season or force a change in the mining methods to allow mining during the winters. A longer or warmer summer season may increase the volume of materials needed to maintain infrastructure. When developing a mineral material pit, there are a multitude of factors to take into consideration. Depending on the type of material and the mining method used to extract that material, a changing climate could make the excavation easier, due to the melting of the permafrost, or more difficult when attempting to develop deposits in areas with melted permafrost, which may necessitate removing water or the need to excavate in swampy conditions.

Direct and Indirect Impacts

Non-oil and gas-associated activities that can affect the sand and gravel resources are primarily associated development, including local infrastructure construction (e.g., roads, airstrips, and pipelines) and contaminated site cleanup. Impacts from these activities will be influenced by the amount of sand and gravel resources removed and the location of mining (e.g., adjacent to waterbodies versus uplands).

Potential impacts from the future development and operation of non-oil and gas development, as well as oil and gas facilities identified in the RFD scenario (**Appendix B**) include the removal of sand and gravel resources for embankment fills. These actions change and disturb the surface vegetation layer and excavate landforms, resulting in changes to surface drainage, erosion of soils, and thawing of permafrost.

The effects of climate change described under the *Affected Environment,* above, could influence the rate or degree of the potential direct and indirect impacts.

Impacts Common to All Alternatives

Under all alternatives, the potential for impact from non-oil and gas-related activities is present. Community-based infrastructure projects would likely have the greatest impact with possible road projects to connect communities with the program area. These impacts will have similar impacts to those described below for the direct impacts on sand and gravel resources.

Under all action alternatives, the BLM would consider permitting sand and gravel areas, with the exception of the Fish Creek 3-mile setback, which would be closed to sand and gravel mining. Under the action alternatives, 22,693,000 acres would be available for sand and gravel mining; however, based on the likely material source soil types, this acreage will most likely be limited to approximately 3.8 million acres.

Sand and gravel resources would be required for future development projects under each of the action alternatives. Sand and gravel resources would need to be extracted for the construction of roads and pads, and investigations specific to material source development would be completed as part of the exploration and development phases of alternative development. Sand and gravel would likely be obtained from more than one newly permitted mine site near the proposed development and would be accessed during winter via ice roads. It is estimated that gravel pits and the associated storage pads needed to supply oil exploration, development and production would encompass approximately 26.8 acres per one million cubic yards of gravel required. The acreage required for gravel mining could increase or decrease depending on local conditions, the available material, and accessibility. Gravel supply plans would be detailed in site-specific NEPA documentation for any future developments (**Appendix B**, **Section B.10**).

Sand and gravel mining would alter the geomorphic landforms and remove vegetation, leading to permafrost thaw. At mine site closure, and depending on site characteristics and reclamation requirements, the mine sites could be inundated with surface water, forming a pond. By changing the drainage patterns of surface water, ponds and channels form and concentrate water that accelerates permafrost thaw. Where drainage patterns are altered, blockages can lead to ponding and sediment deposition. Where drainage patterns redirect surface flow or increase velocities, such as at embankments, sediments erode. Water impoundment in a flooded pit would likely remain unfrozen near the bottom, creating a thaw bulb around and beneath the pit, which may cause the excavation walls to slough and deposit material into the pit (BLM 2018a).

Removal of gravel in the future from areas near or in streams could change stream configurations, hydraulics, flow patterns, erosion, sedimentation, and ice damming (USACE 2018). Remediation of gravel mine sites would be done in accordance with ROP E-8.

The effects of climate change described under the *Affected Environment*, above, are part of the baseline conditions for sand and gravel resources in the project area. See **Section 3.2.1** for a detailed discussion of the alternatives' contributions to global climate change.

Alternative A

Under Alternative A, approximately 8,794,000 cubic yards of material would need to be mined for future gravel pads and roads; this is anticipated to result in surface impacts from mining of about 235 acres. The BLM would expect multiple material source sites to be used to meet the material demands and reduce haul distances. If less production is achieved than anticipated under the high production model, less material would be required.

Alternative B

Under Alternative B, approximately 7,904,000 cubic yards of material would need to be mined for future gravel pads and roads; this is anticipated to result in surface impacts from mining of about 212 acres. The BLM would expect multiple material source sites to be used to meet the material demands and reduce haul distances. If less production is achieved than anticipated under the high production model, less material would be required.

Alternative C

Under Alternative C, approximately 11,098,000 cubic yards of material would need to be mined for future gravel pads and roads; this is anticipated to result in surface impacts from mining of about 297 acres. The BLM would expect multiple material source sites to be used to meet the material demands and reduce haul distances. If less production is achieved than anticipated under the high production model, less material would be required.

Alternative D

Under the Alternative D high production scenario, approximately 15,250,000 cubic yards of material would need to be mined for future gravel pads and roads; this is anticipated to result in surface impacts from mining of about 408 acres. The BLM would expect multiple material source sites to be used to meet the material demands and reduce haul distances. If less production is achieved than anticipated under the high production model, less material would be required.

Cumulative Impacts

The general temporal and geographic scope for the cumulative effects analysis (**Appendix F**, **Section F.3.1**) is from the 1970s through 70 years after the ROD signing and across the North Slope of Alaska and the near-shore marine environment. Potential direct impacts would include permanent changes to landforms and vegetation, due to material extraction, which would lead to changes in permafrost lasting beyond the temporal scope of 70 years after ROD signing. Changes to permafrost would likely be due to thaw and would result in subsidence, formation of thaw bulbs, and changes to drainages in and around the perimeter of the material site. Alternative B would require the least amount of material based on the restrictions and limitations for development, and Alternative D would require more cubic yards of material, compared with the other action alternatives. Past and present actions affecting sand and gravel in the program area are expected to continue, including natural riverbank and slope erosion. The effects of climate change described under the *Affected Environment*, above, could influence the rate or degree of the potential cumulative impacts.

3.2.11 Water Resources

Affected Environment

Water resources in the planning area include rivers, shallow discontinuous streams, lakes, ponds, and coastal estuaries (BLM 2012, Section 3.2.10). Most lakes and streams present in the NPR-A are shallow and tend to freeze early and thaw late. Accessible groundwater is limited to resources beneath rivers and lakes.

Hydrology

Permafrost and seasonal affects restrict the availability of water supplied by lakes, streams, snow, and ice. Most precipitation occurs as snow which contributes to runoff and saturates soils in the spring. As much as 90 percent of annual runoff occurs during the first two weeks of spring and ceases almost entirely by winter.

NPR-A is a dry region; historically precipitation in the planning area has been less than 6 inches during the summer and 5 inches of water equivalent falling as snow during the winter. Precipitation varies between 5.5 inches per year near the coast to 13.4 inches per year in the mountains (Kane et al. 2014). For most of the year, precipitation is stored as snowfall. Snowmelt flooding produces annual peak discharge, typically in June, although summer precipitation can produce minor flooding on larger rivers (Arp et al. 2012a). **Table J-5** and **Table J-7** in **Appendix J** contain historic precipitation and snowmelt data, respectively, for several locations within the NPR-A.

Watersheds, Rivers, and Streams

The North Slope is divided into three distinct hydrologic provinces: Arctic Coastal Plain, Arctic Foothills, and Arctic Mountains (Wahrhaftig 1965; BLM 2012, Map 3-1). Drainage in the planning area is predominantly northward, flowing out of the Brooks Range, through the foothills, across the plain, and discharging into the Beaufort and Chukchi seas. River flow in the Arctic Coastal Plain is nonexistent for most of the year and rivers tend to freeze up early, in December, and break up later, in June. The low-relief of the coastal plain results in low gradient meandering and braided streams. The Arctic Foothills have a slightly higher unit runoff and flow is active for a longer seasonal duration. The Arctic Mountains region is located at the southern boundary of the NPR-A and includes the Colville River, the largest river on the North Slope and the eastern boundary of the NPR-A. The Colville River traverses the De Long Mountains carrying a large volume of glacial sediment load down to the Arctic Ocean and forms a large delta near Nuiqsut. Freeze-up and break-up on the Colville River is complex and persists longer than other rivers in the planning area. When frozen, a saltwater wedge forms beneath the river ice and high salinity water can be found as far as 37 miles from the mouth.

The eastern portion of the planning area includes Ikpikpuk and Colville sub-basins. Within the Ikpikpuk sub-basin, the Ikpikuk River traverses the Arctic Foothills as described in the BLM 2012, Section 3.2.10.1. The Fish Creek drainage basin (drainage area 1805 square miles) originates in the Coastal Plain west of the Colville River delta and contains the Inigok Creek, Judy Creek, and Tinmiaqsigvik (Ublutuoch) River drainage basins. The Tinmiaqsigvik River is a tributary of Fish Creek that connects with Fish Creek 10 river miles upstream from Harrison Bay. The Fish Creek Basin was monitored between 2001 through 2014 during break up and the hydrologic conditions are well documented (Michael Baker Jr. Inc. 2010, 2013, 2014).

Eight major rivers are responsible for draining roughly 95 percent of the planning area; the flow of some of these rivers can be found in **Table J-10** and **Table J-11** in **Appendix J**, and **Map 3-1 in Appendix A** (BLM 2012, Map 3.2.4-1). Additional major streams and rivers of each hydraulic region can be found in the 2012 NPR-A Final IAP/EIS (BLM 2012, Section 3.2.10.1).

Lakes and Wetlands

The lakes and wetlands remain as described in the Affected Environment chapter of the 2012 NPR-A Final IAP/EIS (BLM 2012, Section 3.2.10.1). Lakes represent 10 percent of the surface area in the planning area. Lakes classified by water depth can be found in **Appendix A, Map 3-7**.

The Arctic Coastal Plain has several thaw-lake basins that extend to the foothills at an altitude of about 500 feet covered by thousands of shallow, seasonal, thaw, and drained lakes. The freeze-thaw cycle of moisture-filled soils refill and drain shallow lake basins covering roughly half of the plain. The Arctic Foothills contain a band of hills in which lakes and water supply are scarce. Beyond the foothills, the Arctic Mountains contain some deep glacial lakes and springs, though these lie further east of the planning area (Sloan 1987).

Lakes are plentiful on the Arctic Coastal Plain; a result of patchy permafrost thawing. Shallow lakes, ponds, and marshes develop due to the flat terrain and impermeable permafrost. Shallow lakes less than 6-8 feet deep dominate the Arctic Coastal Plain and usually freeze to the bottom in winter, preserving the permafrost under the lake (BLM 2012, **Appendix A, Map 3-6**). Freezing depth depends on variations such as winter temperature, snow depth, and wind regimes. Historically, ice typically forms in September or October and grows to 6 feet thick by late winter.

Warmer winters with greater snow accumulations means that thinner lake ice forms in the winter (Alexeev et al. 2016). An estimate of 1.5 centimeter per year lake ice thinning was observed on synthetic aperture radar of the Arctic Coastal Plain between 1978 and 2011 (Arp et al. 2012a) and a record low area of bedfast ice extent was observed in 2016-17 due to warm temperatures, late season rainfall, and high snow accumulation (Arp et al. 2018). Lakes near Nuiqsut saw a 21 percent per decade decline in bedfast ice extent as observed from satellite imagery between 1992 and 2011 (Mellor 1987; Arp et al. 2012a). This regime has led to an increase in talik formation beneath shallow lakes. Studies of lakes in the Fish Creek basin show that lakes with bottomfast ice, though they are abundant, averaged only 4.2 percent by surface area, though they are more common within the Ublutuoch river watershed (Arp et al. 2012b).

Five percent of lakes in the planning area intersect the Fish Creek, Colville River, and Ikpikpuk River watersheds. Within the Fish Creek watershed, lakes cover 12-20 percent of the area and drained lake basins cover an additional 10-30 percent of the area (Steufer et al. 2017). A study of lakes in the Fish Creek watershed revealed that one-third of lakes in the area are perennially hydraulically connected, and two-thirds are connected during periods of snowmelt flooding. Higher lake extent and lower drained lake-basin extent corresponds to lower snowmelt and higher baseflow runoff (Arp et al. 2012b).

Several deeper lakes are present in the northern and western areas of the planning area. Teshekpuk Lake is the largest in the area, over 24 miles long.

Groundwater Springs and Aufeis

Groundwater is as described in the 2012 NPR-A Final IAP/EIS (BLM 2012, Section 3.2.10.3). Groundwater resources are minimal primarily because of thick widespread permafrost. Permafrost is impermeable and behaves as a hydrologic confining layer which limits vertical movement of water. Saturated, fine-grained soils in the active layer further hinder percolation and recharge from surface waters. Some potable groundwater can be found in taliks beneath deep lakes and rivers. Shallow supra-permafrost taliks also develop seasonally; however, the thickness is typically less than 4 feet (BLM 2004, Section 3.2.2.1). Unusable intra-permafrost and subpermafrost groundwater has also been found in some locations with high concentrations of dissolved salts, which lower water temperatures below freezing (Hopkins et al. 1955). Deepwater groundwater is available at 1,600–2,500 feet near Utqiaġvik (Kharaka and Carothers 1988).

Perennial groundwater springs have not been located in the planning area. Several groundwater springs have been identified on the North Slope by the observing downstream aufeis in rivers; however, the aufeis were found in rivers east of the planning area.

Nearshore Marine

The NPR-A includes several bays and coastal waters. While the coastal plain is flat, the nearshore is flanked by bluffs and sea cliffs in some locations (Gibbs and Richmond 2015). The nearshore bathymetry is very shallow with numerous shallow lagoons and bays present. The nearshore circulation is wind-driven and responds rapidly to changes, but once an ice cover forms the nearshore circulation becomes very slow. Sea ice coverage begins to decline in mid-April and open water area increases to a maximum of 72 percent in the Beaufort Sea by August or early September. After September, new ice begins to form and ice coverage increases again to 90 percent (Wendler et al. 2014). Groundfast ice is present up to 5 feet of water depth. Open water occurs mainly during intense storms which break up the pack and form leads and polynyas. The sea ice expels brine into the underlying water column and collects in seafloor depressions. Several estuaries are present as well, with pristine water quality.

Water Quantity

Surface water quantity varies seasonally. The lakes identified in the planning area have a combined area of 2,205,00 acres. In the Eastern region of the planning area within the Fish Creek, Colville River, and Ikpikpuk River watershed; lakes cover 117,000 acres.

Of the 85,151 lakes identified in the coastal plain synthetic aperture radar survey, 6,360 lakes (7.5 percent) are estimated to remain a source of winter water within the planning area (Grunblatt and Atwood 2014).

Water Rights

The Alaska Department of Natural Resources Alaska Mapper Water Estate Map indicates that surface water rights and/or temporary water use authorizations exist for the communities located in Atqasuk, Nuiqsut, Point Hope, Utqiaġvik, and Wainwright. Additionally, several oil and gas operators have surface water rights and/or temporary authorizations for operations in the Colville River watershed, including 17 surface water rights and 18 surface water temporary use authorizations. No subsurface permits or water instream reservations are active (ADNR http://dnr.alaska.gov/mlw/mapguide/wr_intro.cfm).

Approximately 528 million gallons of water were withdrawn from freshwater lakes for ice road and drilling pad construction in the NPR-A during the 2017-2018 drilling season as reported by ConocoPhillips-Alaska Inc. to the BLM Arctic District Office (Arp et al. 2019). Water withdrawals for construction begin in December and withdrawals for road and pad maintenance continue through April. Lakes that were pumped have a temporary increase in salinity, calcium, magnesium, sodium, potassium, and chloride levels, and an increase in dissolved oxygen (DO). The pumping effected lakes that were shallow with less volume much more than deeper lakes. There was no notable change in pH, temperature, or nitrates and sulfates levels. Comparable water chemistries between pumped and reference lakes were observed by the August measurements. Obviously, the water surface elevation in the pumped lakes decreased more than the reference lakes in the winter, but recharge seems to replace seasonally withdrawn water volumes. Pumping did not have a notable affect in ice growth. By August, there did not seem to be a difference between lakes that had been pumped and reference lakes (Michael Baker Jr. Inc. 2002). This study counters local observation that "When you extract thousands of gallons of water, it changes the temperature of those streams or lakes" (Nuiqsut) (ABR Inc. et al. 2007).

Water Quality

The surface and ground water quality is described in 2012 NPR-A Final IAP/EIS; including information on the potability, turbidity, alkalinity, DO, and trace metals found in waters within the NPR-A (BLM 2012, Section 3.2.12.2-3). Additionally, an estimate of the early summer suspended sediment concentrations and sediment loads on five rivers of Eastern NPR-A can be found in **Table J-16**, in **Appendix J**. The temporal variability was high; Fish creek suspended sediment loads increased 450 percent over five days of subsequent data collection as discharge increased only 20 percent (Toniolo et al. 2013).

The surface water quality varies seasonally. Shallow thaw lakes are abundant, but seasonal ice-cover increases the dissolved solids present in the remaining water. As water freezes, major ions and impurities are expelled from ice and forced into the water column and sediment. During breakup, soils remain frozen with little infiltration and runoff from newly melted water increases significantly.

Of 34 lakes sampled and studied in the planning area, only six contain notable levels of nitrogen. The lakes in the coastal areas are associated with major ions while lakes in the coastal plains are associated with calcium leached from the underlying geology. All of the observed lakes appear shallow and clear. High DO concentrations were found in all the studied lakes (greater than 9.5 mg/L). Most lakes are moderately acidic and the pH ranges from 5.1 to 8.3. Additional water quality data from this study can be found in **Table J-15** in **Appendix J** (Shaftel et al. 2018).

Another twenty lakes on the arctic plain were monitored between 2012 and 2014 specifically for DO and other environmental conditions; the mean winter DO has implications on freshwater fish habitat availability. Most freshwater fish require a DO level greater than 6 mg/L and levels below 2 mg/L can be lethal. The solubility of oxygen increases with decreasing temperature. DO availability is greatest in the fall when lake ice forms and decreases over the winter until breakup when DO rapidly increases. The initial DO decline was found to be much more rapid in shallow lakes as compared to deeper lakes. The ice cover both isolates the lake from atmospheric affects and reduces photosynthesis, mixing, and heat and gas exchange; thus, restricting oxygen input. 40 percent of the surveyed lakes had a low mean winter DO below 4 mg/L (range 9-20 percent saturation), 25 percent had a moderate DO between 4-10 mg/L (range 32-69 percent saturation), and 35 percent had a high DO above 10 mg/L (range 75-103 percent saturation). Low DO is more typical in shallow lakes with large littoral areas, while deeper lakes with limited littoral area have a higher DO. Microbial processes that consume oxygen have a larger interface with the lake sediment interface in lakes with larger littoral areas (Leppi et al. 2015).

Climate Change

The effects of climate changes have dramatically altered the hydrodynamics in the North Slope. Arctic climate has seen changes in air temperature, sea ice, precipitation, wind intensity, storm events, and cloud cover. One of the most obvious climate changes experienced in the planning area is an increase in air temperature. Most climate models predict a larger rise in temperature in the Arctic as compared with the rest of the globe, as described in **Section 3.2.1** of the *Affected Environment*. Warmer temperatures affect ice formation and shorten the period in which ice roads and frozen drill pads can be utilized.

The annual decline of sea ice coverage over a 34-year period was 4.7 percent per decade in the Chukchi Sea and 4.1 percent per decade in the Beaufort Sea. This trend predicts completely ice-free open water in late August and early September within the next two decades (Wendler et al. 2014). Local observers have noted that "We're seeing first-year ice instead of multi-year ice. Arctic Ocean is melting. Our ice is melting." (Point Lay) (SRB&A 2011a). The longer periods of open water may permit increased maritime traffic; however, the sea ice is no longer armoring or sheltering shorelines.

Sea ice dampens offshore waves during high wind events. As landfast sea ice forms later in the season and sea ice coverage decreases and shifts further offshore; large waves and storm surge can develop. The winds observed at the Utqiaġvik meteorological station are fairly strong year-round but reach an observed maximum in October at 15.4 mph from NNE, before sea ice is at its maximum coverage (Wendler et al. 2014). The warming temperatures have caused permafrost degradation and have combined with sea ice decline, high wind speeds, and larger waves to accelerate coastal erosion. Storm surge during large storms causes freshwater lakes to become inundated with saltwater affecting potable water sources. Salts and other impurities depress the freezing point of water such that it is less suitable for consumption as well as ice road and drill pad construction. The inundation of coastal areas by storm surges is predicted to become more frequent.

The decrease in sea ice also results in a warmer atmosphere and decrease in mean atmospheric pressure; an atmospheric pressure decrease of 1.1 hPa was observed between 1979 and 2012. Warmer air can hold more water vapor and almost 2-inch precipitation increase was observed over the same 34-year period at Utqiaġvik (Wendler et al. 2014). Overall increases in precipitation are likely; a 35-70 percent increase is expected by the 2090s which corresponds to an average of 4.3 additional inches of precipitation throughout the region. SNAP predicts a 1- and 1.7-inch increase in precipitation by 2050 and 2090, respectively; and a 1.6- and 2.7-inch increase of snowfall water equivalent by 2040 and 2090, respectively (SNAP 2018).

The coastal plain will likely see the greatest increase in precipitation. Warming temperatures and lower atmospheric pressure suggest that precipitation will occur more often as rainfall instead of snow on the shoulder seasons. A shift toward earlier spring runoff is already underway and rivers and streams will likely see earlier and stronger peak flows, and greater overall discharge. The growing season typically results in a net-water deficit; and the increase in precipitation will likely be offset by evapotranspiration during the longer growing season and a net water-deficit may occur for longer periods (SNAP 2018).

The decline in sea ice has increased regional precipitation as snowfall which in turn hinders lake ice growth (Alexeev et al. 2016). Forecasts utilizing Global Climate Model, Polar Weather Research Forecast, and European Center for Medium-Range Weather Forecasts Re-Analysis Weather Research Forecast data suggest that lake ice thickness will continue to decline resulting in fewer lakes with bedfast ice. The climate-forced ice growth model mostly overpredicted ice growth, though it did slightly underpredict on occasion. The result is that the number of lakes that can provide overwinter fish habitat and water supply may increase; however, the permafrost beneath will degrade. A similar phenomenon has been observed by local community members:

> *"Some of the lakes are drying up further up river, there used to be lakes further up river and now it is drying up and there is no lakes at all. The changing has to be with the weather pattern and whether or not more ice is being exposed on the river. Where those ice areas are the tundra sinks and erodes"* (Nuiqsut) (**Appendix Y**).

Permafrost depth of active layer in the planning area has increased from 1.6 feet in the 1980s to 1.7 feet in the 2000s and is expected to reach 1.9 feet by 2040 and 2.3 feet by 2090, a 30-40 percent increase. Deeper thawed soils are better for drainage and water storage. As the permafrost thaws, greater runoff and precipitation infiltration will result in a loss of surface waters, which could also be offset by some of the water stored in frozen soils becoming available during the growing season (SNAP 2011).

Overall, there has been a general decrease in the quantity of lakes across the Arctic; however, some locations have seen increases. Thermokarsting creates new lakes as the permafrost thaws and creates new subsided pockets that collect water. In other areas, increased infiltration to groundwater has drained lakes (Smith et al. 2005). Community members have noted that *"The lakes are shallower than what I used to know. They're draining out. Or some of them are just flats now. No water in them"* (Utqiaġvik) (Brewster and George No Date).

There already seems to be a shift from shallow polygonal ponds to deep, narrow trough ponds (Liljedahl et al. 2016). Warming has thawed ice wedges causing subsidence, releasing nutrients and forming trough ponds. It is possible that water stored in the shallow polygonal ponds spills over into the adjacent trough ponds when water levels are high and soils thaw and subside. Eventually, the shallow ponds dry up. These newly formed trough ponds tend to be nutrient rich; however, their geometry creates large seasonal water level fluctuations (Koch et al. 2018).

Direct and Indirect Impacts

The potential impacts on surface water quantity and quality would be similar to those described in BLM 2012, Section 4.5.4; BLM 2004, Section 4F.2.2.2; and BLM 2018, Section 3.2.10. The geographic area relevant for assessing all impacts for water resources includes the watershed boundaries of streams/drainages flowing to/through the program area and the boundaries of waterbodies, including aquifers, contained in the planning area. The temporal scale is as described in **Appendix F**, **Section F.3.1**.

The area of lakes within areas open to leasing under various stipulations for all alternatives is presented in **Table 3-16**.

Table 3-16
Area of Lakes within Areas Open to Leasing and Comparison to Alternative A

Fluid Mineral Leasing Stipulations	Alternative				% Change from Alt. A		
	Alt. A	Alt. B	Alt. C	Alt. D	Alt. B	Alt. C	Alt. D
-	(acres)				-		
Closed	879,000	968,000	404,000	14,000	10%	-54%	-98%
Open, NSO	219,000	296,000	660,000	724,000	35%	201%	231%
Open, Controlled Surface Use	-	-	-	108,000	-	-	-
Open, Timing Limitation	-	-	104,000	210,000	-	-	-
Open, BMP	31,000	-	-	-	-100%	-100%	-100%
Open, Standard Terms & Conditions	777,000	612,000	709,000	819,000	-18%	-5%	10%
Open, Total	996,000	908,000	1,473,000	1,861,000	-9%	48%	87%

The area of lakes within areas available for infrastructure under various stipulations for all alternatives is presented in **Table 3-17**.

Table 3-17
Area of Lakes within Areas Available to Infrastructure and Comparison to Alternative A

Infrastructure Availability	Alternative				% Change from Alt. A		
	Alt. A	Alt. B	Alt. C	Alt. D	Alt. B	Alt. C	Alt. D
-	(acres)				-		
Available	1,278,000	683,000	1,278,000	1,390,000	-47%	0%	9%
Unavailable	408,000	1,036,000	387,000	245,000	154%	-5%	-60%
Unavailable except Coastal	22,000	4,000	22,000	23,000	-82%	0%	5%
Unavailable except Roads & Pipeline Crossings	138,000	82,000	143,000	144,000	-41%	4%	4%
Unavailable except Pipeline Crossings	1,000	2,000	1,000	43,000	100%	0%	4200%
Pipeline Corridor	-	34,000	14,000	-	-	-	-

The length of major rivers within areas open to leasing under various stipulations for all alternatives is presented in **Table 3-18**.

Table 3-18
River Length within Areas Open to Leasing and Comparison to Alternative A

Fluid Mineral Leasing Stipulations	Alternative				% Change from Alt. A		
	Alt. A	Alt. B	Alt. C	Alt. D	Alt. B	Alt. C	Alt. D
-	(river miles)				-		
Closed	930	975	427	426	5%	-54%	-54%
Open, NSO	1,688	1,640	2,161	2,159	-3%	28%	28%
Open, Standard Terms & Conditions	95	98	125	127	3%	32%	34%
Open, Total	1,783	1,738	2,286	2,286	-3%	28%	28%
10-year Lease Deferral	-	184	-	-	-	-	-

The length of major rivers within areas available to infrastructure under various stipulations for all alternatives is presented in **Table 3-19**.

The effects of climate change described in the *Affected Environment* above could influence the rate or degree of the potential direct and indirect impacts.

Table 3-19
River Length within Areas Available to Infrastructure and Comparison to Alternative A

Infrastructure Availability	Alternative				% Change from Alt. A		
	Alt. A	Alt. B	Alt. C	Alt. D	Alt. B	Alt. C	Alt. D
-	(river miles)				-		
Available	121	102	129	129	-16%	7%	7%
Unavailable	660	939	425	425	42%	-36%	-36%
Unavailable except Coastal	-	-	-	-	-	-	-
Unavailable except Roads & Pipeline Crossings	1,899	1633	2,126	2,126	-14%	12%	12%
Unavailable except Pipeline Crossings	1	-	1	1	-100%	0%	0%
Pipeline Corridor	-	7	-	-	-	-	-

Impacts Common to All Alternatives

Management of the waterbodies within Peard Bay and Kasegaluk Lagoon Special Areas and Wainwright Inlet/Kuk River would not change and would remain closed to leasing.

All major rivers in the NPR-A would have 0.5- to 7-mile buffers. Within these buffers, permittees could construct essential pipeline and roads that cross the river, but no other permanent infrastructure would be permitted. ROPs K-1, K-2, K-3, K-4, K-5, and K-14 dictate specific mitigation measures to minimize potential impacts on water resources under Alternative A.

Utqiaġvik community members have expressed concern over placing buffers on migrating rivers:

> *"Ikpikpuk River is a migrating river. It migrates. It moves and sometimes it moves 300 feet a season...What is our -- these boundaries that they are putting at a half mile, three quarter of a mile on the rivers, erodes, I mean, you know, there's some real tough questions in there. But we know that the rivers still migrate. You will see how much the rivers have moved within these years, they've moved miles"* (Utqiaġvik) (BLM 2004c; **Appendix Y**).

Another community member requested the larger buffer:

> *"The people up there would like to see a three mile buffer zone from each side of the river. They don't want to see any roads going across this river. By that, I mean you have three proposed roads going across the Colville and going across Fish Creek on one of these road corridors. There is the initial drilling for the entire NPR-A program that we will be starting soon is based within a few hundred feet from this river. We are adamant and persistent and presume that we should try and stop this because it's one of the most highly prized rivers that we have in the country where the people are concerned. By that, I mean without a buffer zone, where we will protect these rivers, it don't make any difference whether you drill three miles from the ocean shore or fifty miles up the river. It still drains into the entire river stream. Therefore, you have a prevailing chance of destroying the whole river all at one crack." Sam Talak* (Utqiaġvik) (BLM 1982; **Appendix Y**)

Sand and gravel mining

Sand and gravel mining would be subject to permitting in the planning area. In the areas available to sand and gravel mining, the construction of roads may alter the regional hydrology, surface and ground water quality, and groundwater level. The amount of gravel mining under each Alternative can be found in **Map 2-9** in **Appendix A** and **Table 2-1** in **Chapter 2.**

Gravel mines alter the floodplain and drainage paths which impact the flow of adjacent streams including their hydraulics, alignment, and stabilities. Excavated gravel is used to create berms that prevent surface flow to and from the mine and cause thermokarsting. The berm is leveled after mining is complete, and the mine is left as a depression which would impound water and create thaw bulbs. Runoff and produced water from dewatering can be intercepted by both surface water and groundwater and affect surface and groundwater quality. ROP E-8 contains mitigation measures and stipulates that locations outside of active floodplains be considered.

Sand and gravel mining would result in short-term, local, adverse direct impacts. A comparison of the lakes and rivers open to sand and gravel mining under each alternative can be found in **Table J-23** and **Table J-24** in **Appendix J**.

Gravel construction

Construction of gravel pads, roads, air strips, culverts, and bridges would alter the hydrology and water quality. As heavy machinery crosses streams and passes near waterbodies it causes bank erosion, increased turbidity, and rutting that changes the hydraulics and drainage patterns. The presence of equipment near waterbodies increases the likelihood of hazardous contamination. Stormwater runoff, including runoff that contains contamination from vehicles and storage, can affect water quality. ROP A-4 minimizes the impact of contaminants, and ROP A-5 includes a refueling setback. ROP A-4 (Alternative A) minimizes the impact of all contaminants; however, ROP A-4 (all action alternatives) applies to permittees with oil storage capacity of 1,320 gallons or greater of fuel. ROP A-5 (all action alternatives) stipulates that refueling and fuel storage is not permitted within 100 feet of waterbodies for all action alternatives; ROP A-5 (Alternative A) has a setback of 500 feet, which is farther than all action alternatives.

Culverts would alter surface flow and drainage and can either inundate or drain surrounding areas. Undersized culverts can impound water and lead to thermokarsting and affect turbidity and downstream water quality. Alteration of stream hydraulics can cause scour and alter channel stability and alignment as well as potentially deter the passage of fish. ROP E-6 and ROP E-14 (Alternative A) stipulate stream crossings should be designed to allow free passage of fish, reduce erosion, and maintain natural drainage, and they require 3 years of hydrologic data and fish sampling. ROP E-6 (all action alternatives) additionally accounts for sheet flow and permafrost, and it requires 1 year of hydrologic data and fish sampling.

Construction of bridges can cause scour downstream of piles as well as alter channel stability and alignment.

Gravel pads, roads, and air strips would alter natural surface drainage patterns. Flow obstructions can impound flow, prevent connectivity between different floodplains, and cause sedimentation and erosion of tundra. Gravel construction impacts would be mitigated under ROP C-2 and L-1; ground operations would only be permitted when the tundra is frozen and require low-impact, low-pressure vehicles. Causeways are prohibited in river mouths under ROP E-3.

Gravel construction would result in short to long-term site-specific adverse direct impact. A comparison of the Lakes and Rivers open to new infrastructure under each alternative are presented in **Table 3-17** and **Table 3-19**, with more detail provided in **Table J-21** and **Table J-26** in **Appendix J**.

Community infrastructure projects

Community infrastructure projects, including a potential community road routed north of Teshekpuk Lake connecting Nuiqsut and Utqiaġvik, may be permitted with appropriate mitigation measures. Construction projects would directly affect adjacent waterbodies in the short and long terms in manners similar to those pertaining to gravel construction, including alteration of local drainage patterns, impacts on water quality from contaminated runoff during construction, and increased spill risk.

Freshwater withdrawals

Freshwater withdrawals for construction of ice roads and pads, drilling, dust abatement, potable water, and fire suppression would affect regional hydrology, hydraulics, and water quality. Water is withdrawn from lakes in the form of both ice chips and liquid water. Some local community members have expressed concern that water quantity has been affected by oil and gas development, stating that "*. . . when I go to Alpine I see that the lake they use is getting lower. They use it for everything. It's their main source of water. They use it all the time. They must use them a lot. We have used our lake over here and it hasn't gone down or anything. It has always stayed the same" (Nuiqsut) (SRB&A Unpublished-b).* Another local community member, Raymond Neakok, stated that *"Number 1 is: All drilling operations, will take a lot of water. That means the same thing will happen like they did in Sagavanirktok River. They ran it dry, completely dry twice in one year. And, if that happens in the Colville River or any of these places that are printed up here -- like the lakes, the big lakes and river -- if any one of those go dry, the animals are going -- the fish are not going to be there. That's destroying the villages" (Utqiaġvik) (BLM 1982;* ***Appendix Y****).*

Under Alternative A, ROP B-2 sets the guidelines for withdrawal of unfrozen water from lakes; the maximum volume liquid water that may be removed from unfrozen lakes with no fish is 35 percent. Under all action alternatives, ROP B-2 allows no more than 20 percent of liquid water removed and limits the combined withdrawal of ice aggregate and water to 20 percent, which is also less than the volume permitted under Alternative A.

When water in any form is removed from its native location and placed elsewhere, it inevitably disrupts drainage, both surface and groundwater levels, and alters the water quality as described in **Section 3.2.11** of the *Affected Environment.*

Liquid water withdrawals would affect the volume of water available to fish species and its water chemistry and temperature. Installation of intakes would increase turbidity. ROPs B-1 and B-2 would mitigate some of the impact of freshwater withdrawals and include by prohibiting removal of water from rivers and streams and placing limitations on withdrawal in waters with overwintering fish, limit withdrawal volume to 20 percent of total lake volume, and set guidelines on intakes. Water withdrawals would result in short-term site-specific adverse direct impact.

Ice construction

Ice roads and pads may affect drainage patterns and create obstructions to flow, thus affecting channel stability or alignment and potentially leading to erosion, scour, and deposition of the resulting sediment as described in **Section 3.2.11** of the *Affected Environment.* A typical ice pad used during exploration drilling would require 1.5 million gallons of water (BLM 2018b) and an ice road can use approximately 1 million gallons of water per mile (BLM 2012). Ice roads and pads are constructed to minimize damage to tundra (ROP C-2) and mitigate hindrances to fish passage through the requirement that roads are removed or breached at the end of the season (ROP C-3). Under all alternatives, river crossings should be kept clean, at a low angle, and removed before breakup. Additionally, under all action alternatives, ROP C-3 requires ice thickness and water depth data as well as photographic evidence that crossings have been removed. Spring thaw would affect groundwater quality.

If the insulating snow cover is removed from the ice to construct ice roads it can increase freezing depth, impact DO concentrations, isolate portions of the lake, and restrict circulation. Ice construction would result in direct short-term site-specific adverse direct impact. ROP C-3 mitigates winter crossings of waterways to reduce impacts on surface water quality.

Marine traffic

An increase in barges accessing the coastline increases the risk of hazardous spills which would impact water quality. The extent of the impact would be related to the contaminant, size, and timing. The planning area experiences long periods of darkness during winter months which make it difficult to locate and clean up spills. The seasonal presence of broken ice poses an additional challenge to spill cleanup. A spill would result in long-term regional adverse direct impact.

Marine traffic includes barge support of local communities, barge support of infrastructure projects, scientific research, seismic surveys, marine subsistence activities, and barge support of drilling activities. All development scenarios include the construction of at least one barge landing. Barge propellers stir up bottom sediments and cause a temporary increase in turbidity.

Terrestrial traffic

Traffic on roads and off roads is expected to increase and includes travel between communities, access to subsistence sites, recreation, and scientific research. Dust created during travel can increase turbidity in adjacent waterbodies and cloud stormwater runoff locally in the short term. One local community member expressed his concern that *"Even [Eleanor Lake] that is here is not usable here, where we used to get ice and get water. We can't use it anymore because there has been too much human activities; you know, skidoos and snowmachines spill oil, and it makes it not useful" (Anaktuvuk Pass) (SRB&A Unpublished-a).*

River and lake traffic

Use of rivers and lakes to travel between communities, to access subsistence sites, and for recreation and scientific research is expected to continue. Use of rivers and lakes by motorized vessels increases the risk of potential hazardous material spills that locally affect water quality in the short term. ROP C-4 prevents travel up and down streambeds except at crossings, which must have grounded ice whenever possible; however, ROP C-4 (all action alternatives) additionally allows exceptions for vehicles collecting snow or ice aggregate where ice is grounded.

Drilling and Operations

Drilling and completing a production well can require 420,000 to 8 million gallons of water, which is mixed with clay and chemicals in order to lubricate the drill bit, provide positive pressure, and stabilize the wellbore (BLM 2012, 2019). Production entails the use of large volumes of water to frack and waterflood to maintain reservoir pressure; however, gas reinjection can also be used in conjunction or in place of water. The water used to drill and develop would be sourced locally, from a seawater treatment plant and/or produced water.

Under all alternatives, the drilling fluid has to be stored, reused, and disposed. Discharge of produced water is managed by ROP A-7 (Alternative A), while under all action alternatives, the State of Alaska would set requirements. The State of Alaska regulates pollutant discharges to surface water under the Alaska Pollutant Discharge Elimination System and Alaska Department of Environmental Conservation (ADEC) wastewater discharge authorizations. Drilling operations would use various hazardous substances that would affect surface and groundwater quality if they spill.

Under Alternative A, Best Management Practice (BMP) A-3 minimizes oil and gas pollution through planning requirements, and under all action alternatives the pollution planning requirements may refer to elements that meet federal, state, or local requirements. Under Alternative A and BMP E-4, pipelines are authorized under a quality assurance/quality control plan; under all action alternatives, there will be no BLM requirement, and the State of Alaska will enforce pipeline design and construction. Production of oil also poses a risk to surface and groundwater quality in the event that casing, cement, or blowout preventers fail. Groundwater contamination or a spill would result in a long-term, local, adverse impact. Surface casing and cement are used to isolate drilling fluids and oil from the groundwater supply and protect the aquifer. ROP A-4 outlines spill prevention stipulations to protect water resources.

The impact of a development's footprint is mitigated under ROP E-5 (Alternative A); under all action alternatives, ROP E-5 would include a requirement that impermeable liners be used under gravel to further mitigate contaminant spills and that they be located outside areas important for habitat, subsistence use, and recreation. Pipeline construction would entail trenching or aerial crossing of rivers and would increase turbidity during construction. ROP E-2 mitigates impacts of infrastructure on water quality by prohibiting permanent infrastructure within 500 feet of fish-bearing waterbodies except for essential pipeline and road crossings.

Seawater treatment plants could be used to provide water for drilling and production, and any brine effluent discharged would affect local marine water quality, chemistry, and temperature.

ROP G-1 mitigates long-term adverse effects during abandonment of gas and oil fields when operations cease. Drilling and operations would result in site-specific adverse impacts. A comparison of the lakes and rivers open to leasing under each alternative can be found in **Table J-20** and **Table J-25** in **Appendix J**.

Marine in-water work

Pipelines connecting near-shore marine drill sites will potentially utilize pipelines to connect to the TAPS. In-water work to excavate and bury the pipeline will disturb bottom sediments, increase turbidity, and increase the risk of an in-water contaminant spill. Contaminant spills could affect the NPR-A coastline and adjacent waterbodies. Causeways built to protect pipelines or provide access to near-shore marine sites will significantly affect local and regional hydraulics and water quality.

Operational Activity

Access and activity are accompanied by an increase in personnel. This would require potable water and increase domestic wastewater discharged to surface waters, which impacts water quantity and quality. Operational activity includes, but is not exclusive to, personnel supporting scientific research, recreational users, subsistence users, and personnel developing natural resources. ROP E-2 states that permanent facilities are prohibited within 500 feet of the ordinary high water mark of fish-bearing waterbodies, and camps are prohibited on frozen lakes and river ice. Operational activity would result in short-term, local, adverse impacts.

ROP A-13 dictates that aqueous film-forming foam used for firefighting must be properly disposed along with runoff and wastewater; there is no similar ROP under Alternative A.

Climate Change

The effects of climate change described under the *Affected Environment*, above, are part of the baseline conditions for water resources in the project area. See **Section 3.2.1** for a detailed discussion of the alternatives' contributions to global climate change.

Alternative A

Current management actions would continue, and changes would follow current trends. Additional activities associated with community infrastructure projects, scientific and agency research, seismic surveys in unleased areas, and recreational activities would continue to occur throughout the NPR-A. The area of lakes and length of major rivers that would continue to be managed under current management actions are presented in **Table 3-16**, **Table 3-17**, **Table 3-18**, and **Table 3-19**. Impacts from post-lease oil and gas activities, non-oil and gas activities, and oil and gas activities in unleased areas would be as described under *Impacts Common to All Alternatives.*

Under Alternative A, the water required to complete wells in million gallons ranges from 25 to 640 for the low development scenario, 126 to 3,200 for the medium development scenario, and 252 to 6,400 for the high development scenarios. Peak gallons of water per day required to maintain oil production pressure, assuming gas is not being reinjected, would be 2,898,000 for the low development scenario, 5,082,000 for the medium development scenario, and 12,096,000 for the high development scenario as found in **Table J-19** in **Appendix J**.

Impacts Common to All Action Alternatives

Sand and gravel mining would be subject to permitting in the planning area, with the exception of 61,000 acres that would be closed to sand and gravel mining along a 3-mile Fish Creek setback downstream from the eastern edge of Section 31, T I N, R I E, U.M. The restriction closes and protects 49 river miles of Fish Creek from mining. In the areas available to sand and gravel mining, the construction of roads may alter the regional hydrology, surface and ground water quality, and groundwater level. All action alternatives include 2,664 river miles that would be in areas eligible for sand and gravel mining. ROP E-8 includes a stipulation that extraction from active river channels and streams is prohibited without a hydrological study that indicates no impact on streamflow and water quality.

Alternative B

The area of lakes and rivers within areas open to leasing or infrastructure under various stipulations for all alternatives, including the difference between Alternatives B and A, is presented in **Table 3-16** to **Table 3-19**. Activities associated with community infrastructure projects, scientific and agency research, seismic surveys in unleased areas, and recreational activities would continue to occur throughout the NPR-A as describe under the *Impacts Common to All Alternatives*.

Under Alternative B, new infrastructure is prohibited over a large area of coastline, including Admiralty Bay, Smith Bay, and Teshekpuk Lake, except for two pipeline corridors. Fish Creek, Judy Creek, Kikiakrorak River, Kogosukruk River, and Ublutuoch River, approximately 184 river miles, would be subject to a 10-year lease deferral. Of all the alternatives, Alternative B provides the fewest major rivers in areas open to leasing, amounting to 975 river miles, including the Avalik River, Etivluk River, Fish Creek, Ikpikpuk River, Inaru River, Inicok River, Judy Creek, Kaolak River, and others closed under Alternative C.

The impact of the two pipeline corridors permitted near Teshekpuk Lake would be local and similar to those discussed under Gravel Construction.

Alternative B includes the least land available for development, and as such, would include the least sand and gravel mining (as found in **Table J-23** in **Appendix J**), gravel construction, ice construction, and drilling and operations, and the potential impacts would be less than those discussed under Alternative A.

Under Alternative B, peak gallons of water per day required to maintain oil production pressure would be 10 percent less than required under Alternative A.

Alternative C

The area of lakes and rivers within areas open to leasing or infrastructure under various stipulations for all alternatives, including the difference between Alternatives C and A, is presented in **Table 3-16** to **Table 3-19**. Activities associated with community infrastructure projects, scientific and agency research, seismic surveys in unleased areas, and recreational activities would continue to occur throughout the NPR-A as described under *Impacts Common to All Alternatives*.

Under Alternative C, new infrastructure is permitted along the boundaries of the Utukok River Uplands Special Area, which is an additional 7 percent increase in the river miles potentially affected by development compared with Alternative A. Alternative C increases the area available to new infrastructure by 7 percent in river miles compared with Alternative A. A single pipeline corridor would be permitted near Teshekpuk Lake. There is a 28 percent increase in river miles open for leasing and a 7 percent increase in river miles available for new infrastructure compared with Alternative A.

Under Alternative C, peak gallons of water per day required to maintain oil production pressure would be 26 percent greater than required under Alternative A.

Alternative D

The area of lakes and rivers within areas open to leasing or infrastructure under various stipulations for all alternatives, including the difference between Alternatives D and A, is presented in **Table 3-16** to **Table 3-19**. Activities associated with community infrastructure projects, scientific and agency research, seismic surveys in unleased areas, and recreational activities would continue to occur throughout the NPR-A as described under *Impacts Common to All Alternatives*.

Under Alternative D, new infrastructure is permitted over the largest area including a 28 percent increase in river miles open for fluid mineral leasing (from Alternative A). Under Alternative D, more land is available for leasing and more water would likely be needed for exploration and production, as well as more potable water required for drilling facilities. The most rivers are in areas available for leasing, cumulatively 127 river miles, and the fewest major rivers in areas closed to leasing, 426 river miles. Alternative D has the same river miles available to infrastructure as Alternative C.

Under Alternative D, the acreage of lakes in areas open in some form to leasing would increase 87 percent compared to Alternative A. The acreage of lakes available to new infrastructure would increase 9 percent compared to Alternative A.

Alternative D includes the most land available for development, and as such, would likely include the most sand and gravel mining, gravel construction, ice construction, and drilling and operations and the potential impacts would be the same as those discussed under *Impacts Common to All Alternatives*.

Under Alternative D, peak gallons of water per day required to maintain oil production pressure would be 74 percent greater than required under Alternative A.

Cumulative Impacts

The potential cumulative effects on surface water would be similar to those described in BLM 2012, Section 4.8.7.4.

Oil and gas exploration and development, as discussed in **Appendix F, Section F.3.1**, would continue and include additional exploration, production, and infrastructure. These developments would continue to affect waterbodies and the regional hydrology in the manner previously discussed above including the Colville River, Sakoonang Channel, Nechelik Channel, Ublutuoch River, Fish Creek, Judy Creek, Kulikpik River, and others. Potential offshore development in the nearshore marine area, as discussed in **Appendix F, Section F.3.1**, would also continue to affect waterbodies and the regional hydrology in the manner previously discussed above. Activities associated with community infrastructure projects, scientific and agency research, seismic surveys in unleased areas, and recreational activities would continue to occur throughout the NPR-A, and the effects will accumulate as described under *Impacts Common to All Alternatives.*

Advances in technology, such as the use of rolligons, ice roads, snow trails, and ice pads, would mitigate damage to the tundra and floodplains. The use of a single pad and horizontal drilling to drill multiple well bores would reduce disturbance to floodplains and is a more efficient use of water for drilling fluids and reinjection.

Gravel mining for construction and maintenance of roads and development for both communities and private entities would continue to impact surface water and ground water quality in the manner previously discussed above. The continuation of infrastructure to sustain North Slope communities is anticipated.

Marine traffic is projected to increase with decreases in sea ice associate with climate change, and the risk of oil or hazardous contaminants spilling into marine bodies would increase as well in the manner previously discussed above.

The effects of climate change described under *Affected Environment* above could influence the rate or degree of the potential cumulative impacts.

3.2.12 Solid and Hazardous Waste

Affected Environment

Past and present activities within the NPR-A have resulted in solid and hazardous waste impacts on the environment. Historical activities associated with solid and hazardous waste impacts include the U.S. Department of Defense construction of the Distant Early Warning Line stations, short- and long-range radar sites, and research facilities, and oil and gas exploration by the U.S. Navy and the USGS. More recent activities include private oil and gas exploration and transportation of fuel and goods to the North Slope Borough (NSB) communities on winter trails. The communities of Nuiqsut, Utqiaġvik, Atqasuk, and Wainwright have active landfills operating under the ADEC solid waste program regulations.

Department of Defense Sites

The Department of Defense created transportation corridors, staging areas, small landfills (discussed below), camps, and fuel caches for former Distant Early Warning Line sites in Icy Cape, Wainwright, Peard Bay, Point Barrow, Cape Simpson, Point Lonely, and Kogru. The Department of Defense also established short- and long-range radar capabilities in Wainwright, Point Barrow, and Point Lonely and Naval Arctic Research Laboratory remote sites at No Luck Lake, Brady, and the northwest shoreline of Teshekpuk Lake. Cleanup activities are ongoing at Department of Defense identified sites in the NPR-A; see the 2012 NPR-A Final IAP/EIS (BLM 2012, Section 3.2.11.1) for further information on the status of cleanup activities at these sites. All Distant Early Warning Line sites remedial actions are planned or conducted under the Comprehensive Environmental Response, Compensation and Liability Act. Although the Department of

Defense has cataloged drum caches and staging areas established for research, exploration, or training, new areas are being discovered.

Oil and Gas Exploration and Development

Legacy Oil and Gas Well Sites and Reserve Pits

During early exploration programs from 1944 to 1982, the U.S. Navy and the USGS drilled 136 wells and core holes, known as legacy wells within and adjacent to the NPR-A. Hazardous materials and solid waste are associated with the legacy wells, including camp wastes, empty drums, and reserve pits. See **Appendix A**, **Map 3-38** for the location of these wells. Five legacy sites also had gravel airstrips, and unmaintained airstrips are still in use at Inigok and Driftwood.

The BLM ranked the condition of USGS legacy wells and began a program to plug and abandon wells it has deemed to be risks (BLM 2013b). The agency concluded that 68 wells require no action, 18 are still in use by the USGS, and 50 require remediation (BLM 2013c). Higher-risk wells are targeted for immediate remediation with lower-ranked wells remediated on a case-by-case basis.

Twenty-eight of the legacy wells had associated reserve pits to capture drilling muds and fluids during drilling. **Appendix A**, **Map 3-38** shows the location of reserve pits, which are regulated by the State of Alaska under its Inactive Reserve Pit closure regulations. The reserve pits are inactive and are considered closed by the ADEC solid waste division. Reserve pits and their status are described in Section 3.2.11.3 of the 2012 NPR-A Final IAP/EIS (BLM 2012).

Current Oil and Gas Development Projects

Current oil and gas developments in the NPR-A are Colville Delta-5 of the Alpine development, GMT1, and GMT2. These developments and exploration activities generate, manage, and dispose of solid and hazardous waste according to federal, state, and local regulations.

Landfills and Alaska Department of Environmental Conservation Contaminated Sites

Landfills are used to dispose of solid waste (construction debris, trash, and human waste), asbestos, petroleum-stained soils, lead-based paints, and polychlorinated biphenyl-contaminated gravels. Small, solid-waste landfills have been associated with many of the legacy wells. Department of Defense landfills were constructed prior to ADEC regulations that were implemented in January 1996 and include Umiat, Kogru, Point Lonely, Peard Bay, Wainwright, Icy Cape, and possibly No Luck Lake, Brady, and the Teshekpuk Lake Naval Arctic Research Laboratory cabin. Landfills have been removed from Point Lonely and Wainwright. Active landfills operating under ADEC regulations include Atqasuk, Utqiaġvik, Nuiqsut, and Umiat.

For more information on landfills, see Section 3.2.11.3 of the NPR-A Final IAP/EIS (BLM 2012).

The BLM reviewed the ADEC contaminated sites database to identify contaminated sites not associated with Department of Defense projects, oil and gas exploration and development, or landfills. There are 30 ADEC sites within the NPR-A: 7 where cleanup is complete, 5 where cleanup is complete with institutional controls, 17 that are active, and 1 is informational.

Other Uses

Commercial, research, field management, archaeological/paleontological digs, and subsistence activities in the planning area may use winter overland transportation trail corridors; some were trails established during the U.S. Navy exploration era. More recent uses are the commercial hunting guide camps authorized by special recreation permits. Informal campsites and modern remote fuel caches have been established in the planning area to support helicopters flying for research and field management. Petroleum products may have been spilled in the past as a result of these activities. Current state law requires all travelers to be responsible for adequate prevention of spills and for prompt notification and cleanup should a spill occur.

Under authority of the Resource Conservation and Recovery Act, the EPA regulates facilities that generate, transport, store, treat, and/or dispose of solid and hazardous waste. There are several Department of Defense, oil and gas development projects, and community facilities also listed as Resource Conservation and Recovery Act facilities (e.g., Barrow power plant, Alpine oil field, and Kogru River Distant Early Warning Line site).

Climate Change

Documented climate change (SNAP 2018) impacts affect landfills or other infrastructure sites in the NPR-A through shoreline erosion and permafrost degradation, resulting in land subsidence. This increases the active layer and groundwater depth and exposes contaminated sites along shorelines. Climate change may also alter weather patterns, where higher frequency storms in the summer and fall months could inundate infrastructure or cause saltwater intrusion. Climate change could result in a solid or hazardous waste release to the environment, threatening human health, subsistence resources, and the environment. For more information on coastal or lakeshore erosion resulting in the exposure and release of contamination to the environment, see Section 3.2.11.3 of the NPR-A Final IAP/EIS (BLM 2012).

Direct and Indirect Impacts

Non-oil and gas activities, including local activities associated with subsistence and off-road travel, recreational activities (camping, hiking, and hunting off-road travel), and scientific activities and archaeological/paleontological digs, would not generate large amounts of waste and would consist primarily of solid waste; solid waste would be collected and disposed of at disposal sites in local communities. Solid waste from community infrastructure projects such as road construction or pipelines would be stored in large trash receptacles or approved containers at each site until they are incinerated or transported to an approved landfill. Burnable waste would be handled as described below in *Impacts Common to All Alternatives*.

Issuing oil and gas leases would have no direct impacts on the environment; however, every post-lease action has the potential to generate solid and hazardous material waste and increases the potential for a spill in or adjacent to the NPR-A. The impacts of future exploration and development activities that may occur because of the issuance of leases are considered potential indirect impacts of leasing. Such post-lease activities could include seismic and drilling exploration, development, transportation of oil and gas in the NPR-A, and abandonment. **Appendix B, Section B.3** identifies oil and gas actions that would likely occur. This analysis includes potential direct and indirect impacts on solid and hazardous materials from on-the-ground post-lease activities, non-oil and gas activities, and oil and gas activities in unleased areas, such as seismic exploration and pipelines transporting oil from off-shore leases.

Potential impacts from future post-lease activities and oil and gas activities in unleased areas include the generation, transport, storage, use, and disposal of solid waste, wastewater, produced fluids, drilling muds, and spills of oil, salt water, and hazardous substances (see **Appendix I, Section I.2.**). Analysis of these impacts is tiered from information contained in Section 4.2.2.1 of the NPR-A IAP/EIS (BLM 2012).

Spills can originate from pipelines, storage tanks, production facilities and infrastructure, drilling rigs, heavy equipment or vehicles, and marine transport of supplies. Impacts from spills vary, based on material type, size, and season. For this analysis, the materials that could be spilled associated with post-lease activities or oil and gas activities in unleased areas are categorized and described as follows:

- Produced fluids are composed of crude oil, natural gas, and brine and formation sand.
- Crude oil is oil separated from the brine, natural gas, formation sand, and other impurities and would be transported in the proposed pipeline.
- Refined oil is Arctic diesel, Jet-A 50, unleaded gasoline, hydraulic fluid, transmission oil, lubricating oil and grease, waste oil, mineral oil, and other products.
- Other hazardous materials are methanol, propylene and ethylene glycol (antifreeze), water soluble chemicals, corrosion inhibitor, scale inhibitor, firefighting foam (aqueous film-forming foam), drag reducing agent (e.g., DRA Flo XL), and biocides.

Appendix I includes spill projections for the NPR-A from the hypothetical development scenarios (**Table I-1** in **Appendix I**) and provides analysis on the fate and behavior of spilled oil on tundra and water. The rate of potential oil, saltwater, and hazardous substance spills from the hypothetical development scenario (**Appendix B**, **Section B.8**) is likely to be lower than the history of the past 30 years of oil exploration, development, production, and transportation on the North Slope. The combination of federal and state regulations, continually improving industry operating practices, and advancements in best available control technology reduce the probability and size of future spills (BLM 2004, Section 4.3.1).

Impacts Common to All Alternatives

Post-lease activities, non-oil and gas activities, and oil and gas activities in unleased areas under all alternatives would generate solid waste, consisting of food, sewage sludge, and other nonhazardous burnable and unburnable wastes. Solid wastes would be separated and stored in large trash receptacles or approved containers at each site until they are incinerated or transported to an approved landfill. Burnable wastes would be incinerated, which would temporarily affect air quality. ROPs A-1 and A-2 would require operators to manage solid waste storage and removal for any development and to reduce potential impacts on the surrounding environment. Activities would also generate hazardous waste that would be handled and disposed of according to local, state, and federal regulations.

All alternatives would use injection Class 1 and Class 2 wells to dispose of wastewater, produced water, spent fluids, and chemicals according to ROP A-2, 18 Alaska Administrative Code (AAC) 70, 18 AAC 72, and 18 AAC 83, and as approved by the EPA, the Alaska Oil and Gas Conservation Commission, or ADEC. As a result, injection of wastewater reduces potential impacts on surface waters or the land by injecting wastewater deep underground into zones isolated from drinking water sources.

The potential occurrence of spills does not depend on any alternative chosen, as spills are not a planned activity and are unpredictable in cause, location, size, time, duration, and material type (Mach et al. 2000). **Table I-1** in **Appendix I** includes the number of assumed oil spills and the estimated total spill volume for each alternative.

Alternatives differ in potential direct and indirect impacts from post-lease activities, non-oil and gas activities, and oil and gas activities in unleased areas, due to differing proximity to existing legacy wells, Resource Conservation and Recovery Act sites, and ADEC contaminated sites. However, local, state, federal, and proposed ROPs would minimize disturbance or spread of contamination from these sites.

The effects of climate change described under the *Affected Environment*, above, are part of the baseline conditions for solid and hazardous waste in the project. See **Section 3.2.1** for a detailed discussion of the alternatives' contributions to global climate change.

Alternative A

Current management practices would be maintained, as described in the 2012 IAP. Assumed spills over the development life of the NPR-A for Alternative A would be approximately 7,333 barrels (**Table I-1** in **Appendix I**). Potential impacts on solid and hazardous waste from post-lease oil and gas activities, non-oil and gas activities, and oil and gas activities in unleased areas under Alternative A would be the same as identified under *Impacts Common to All Alternatives*.

Alternative B

Assumed spills over the development life of the NPR-A for Alternative B would be approximately 6,584 barrels, a 10 percent decrease compared with Alternative A (**Table I-1** in **Appendix I**). Post-lease oil and gas activities under Alternative B would be similar to Alternative A for encountering contamination associated with known contaminated sites because there is a similar amount of land available for leasing (only a 3 percent decrease compared with Alternative A). Potential impacts on solid and hazardous waste from post-lease oil and gas activities, non-oil and gas activities, and oil and gas activities in unleased areas under Alternative B would be the same as identified under *Impacts Common to All Alternatives*.

Alternative C

Assumed spills over the development life of the NPR-A for Alternative C would be approximately 9,230 barrels, a 26 percent increase compared with Alternative A (**Table I-1** in **Appendix I**). Post-lease oil and gas activities under Alternative C would be more likely than activities under Alternative A to encounter contamination associated with known contaminated sites because 45 percent more land is available for leasing (**Table 2-1** in **Chapter 2**). Potential impacts on solid and hazardous waste from post-lease oil and gas activities, non-oil and gas activities, and oil and gas activities in unleased areas under Alternative C would be the same as identified under *Impacts Common to All Alternatives*.

Alternative D

Assumed spills over the development life of the NPR-A for Alternative D would be approximately 12,667 barrels, a 73 percent increase compared with Alternative A (**Table I-1** in **Appendix I**). Post-lease activities under Alternative D would be more likely than activities under Alternative A to encounter contamination associated with known contaminated sites because 56 percent more area is available for leasing (**Table 2-1** in **Chapter 2**). Potential impacts on solid and hazardous waste from post-lease oil and gas activities, non-oil and gas activities, and oil and gas activities in unleased areas under Alternative D would be the same as identified under *Impacts Common to All Alternatives*.

Cumulative Impacts

The cumulative effects analysis area for solid and hazardous materials includes the NPR-A. The temporal scale spans from the 1970s through 70 years after the ROD is signed, as defined in **Section F.3.1** of **Appendix F**. This section tiers to Sections 4.8 and 4.12 of the NPR-A IAP/EIS (BLM 2012).

In the NPR-A there are 17 active ADEC contaminated sites, 5 ADEC contaminated sites with institutional controls, and 14 active Resource Conservation and Recovery Act sites. Of the legacy wells in the NPR-A, 18 are partially plugged, 3 need surface cleanup, 15 need to be plugged and have surface cleanup, and 1 needs monitoring. Those engaged in post-lease oil and gas activities, non-oil and gas activities, or oil and gas activities in unleased areas may encounter contamination from past or present projects, and they could introduce or spread solid or hazardous waste into the environment.

Cumulative impacts from the alternatives are similar. Small spills of less than 100 gallons are inevitable events that have the potential to occur at any time. Spills resulting from post-lease development will add to the number of spills annually from the oil industry and other reasonably foreseeable future developments in the NPR-A; spill projections vary between alternatives from 6,584 barrels for Alternative B to 12,667 barrels for Alternative D (**Table I-1** in **Appendix I**). Implementing BMPs and spill prevention and response planning, and performing regular maintenance and monitoring can reduce the potential for a large spill to occur.

The effects of climate change, described in *Affected Environment*, above, could influence the rate or degree of the potential direct and indirect impacts from legacy, Resource Conservation and Recovery Act, and ADEC contaminated sites, or potential oil spills on the environment.

3.3 BIOLOGICAL RESOURCES

3.3.1 Vegetation

Affected Environment

General Vegetation

Descriptions of the vegetation types that occur in the planning area, and previous vegetation mapping efforts in the area, are provided in Section 3.3.1.1 of the 2012 IAP/EIS (BLM 2012). For this revised IAP/EIS, analysis is based on a more recent land cover map produced by the North Slope Science Initiative (NSSI). The portion of the NSSI map that covers the planning area was derived by integrating the data from three raster map sources:

- Existing maps produced by the BLM and Ducks Unlimited in the mid-1990s, cross walked to the NSSI classification scheme
- New mapping based on Landsat data with 30-meter resolution
- A statewide land cover map developed by the Alaska Center for Conservation Science

Details of the vegetation classification and mapping methods used in the NSSI map are provided in the summary report (Ducks Unlimited 2013). The NSSI land cover map includes 25 classes, including 4 forest classes that do not occur in the planning area. The acreages for each of the 21 vegetation and land cover types that occur in the planning area are provided in **Table 3-20**. The descriptions of each vegetation and land cover type, including information on distribution in the planning area as well as typically occurring plant species, are presented in **Appendix K, Table K-1**. The crosswalk between these vegetation types and wetland classes in the planning area is presented in **Appendix K, Table K-2**. The distribution and extent of an aggregated set of 9 broad-scale vegetation and land cover classes (collapsed from the full set of 21 classes) that occur in the planning area are illustrated on **Map 3-10** in **Appendix A.**

The planning area is strongly dominated by three vegetation types: Tussock Shrub Tundra, Tussock Tundra, and Wet Sedge; combined, these types account for 67 percent of the acreage in the area. Two aquatic types (Open Water, including both riverine and lacustrine waterbodies, and Fresh Water Marsh: *Carex aquatilis*) are also very common, accounting for another 18 percent of the planning area. The other 16 types combined represent 15 percent of the planning area and range from Bare Ground, *Dryas* Dwarf Shrub, Birch Ericaceous Low Shrub, Low-Tall Willow along stream drainages, to Fresh Water Marsh: *Arctophila fulva* in lacustrine water bodies.

Table 3-20
Vegetation and Wetlands in the Planning Area

Vegetation Class[1]	Wetland Type	Area (acres)[2]	% of Planning Area
Open Water	Open Water	2,358,000	10
Marine Beach/Beach Meadow	Marine Intertidal	<500	0
Coastal Marsh	Estuarine Intertidal Vegetated	7,000	0
Fresh Water Marsh: *Arctophila fulva*[3]	Freshwater Emergent	90,000	0
Fresh Water Marsh: *Carex aquatilis*[3]	Freshwater Emergent	1,849,000	8
Wet Sedge	Freshwater Emergent	2,741,000	12
Wet Sedge - Sphagnum	Freshwater Emergent	<500	0
Mesic Herbaceous	Freshwater Emergent	42,000	0
Mesic Sedge-Dwarf Shrub Tundra	Freshwater Emergent	531,000	2
Tussock Tundra	Freshwater Emergent	5,009,000	22
Tussock Shrub Tundra	Freshwater Emergent	7,584,000	33
Dwarf Shrub	Freshwater Shrub	712,000	3
Birch Ericaceous Low Shrub	Freshwater Shrub	229,000	1
Low-Tall Willow	Freshwater Shrub	955,000	4
Alder	Freshwater Shrub	46,000	0
Dryas Dwarf Shrub	Uplands	236,000	1
Bare Ground	Uplands	308,000	1
Sparsely Vegetated	Uplands	253,000	1
Unclassified	Unknown	3,000	0
Ice / Snow	Unknown	276,000	1
Burned Area	Unknown	<500	0
Total Planning Area		23,230,000	100

[1] Vegetation classes derived from the NSSI land cover map for the North Slope (Ducks Unlimited 2013)

[2] Acreage values rounded to the nearest 1,000 acres

Sensitive Plant Species

BLM sensitive plant species are a subset of the BLM special status species category. Ten BLM sensitive plant species are currently known to occur within planning area, based on data obtained from Alaska Center for Conservation Science in July 2019: alpine Whitlow-grass (*Draba micropetala*), Adam's Whitlow-grass (*Draba pauciflora*), Drummond's bluebell (*Mertensia drummondii*), Kokrine's locoweed (*Oxytropis kokrinensis*), arctic poppy (*Papaver gorodkovii*), Sabine grass (*Pleuropogon sabinei*), Alaskan bluegrass (*Poa hartzii* spp. *alaskana*), cottonball bluegrass (*Poa sublanata*), sheathed alkaligrass (*Puccinellia vaginata*), and grassleaf sorrel (*Rumex aureostigmaticus* [=*R. graminifolius*]). Additional information on most of these species, including their distribution within the planning area, habitat requirements, and population status, can be found in Section 3.3.8.1 of the 2012 IAP/EIS. Three of these species (*O. kokrinensis*, *P. sublanata*, and *P. vaginata*) were added to the BLM sensitive plants list since the 2012 IAP/EIS was prepared. Conversely, 2 species discussed in the 2012 IAP/EIS—oriental Junegrass (*Koeleria asiatica*) and circumpolar cinquefoil (*Potentilla stipularis*)—have since been removed from the sensitive plants list.

An additional 12 species designated as sensitive by BLM-Alaska have been documented to occur on the North Slope (BLM 2012, Section 3.3.8.1); this assessment was based on information from Cortés-Burns et al. (2009) and the National Plants Database (USDA-NRCS 2019). These species have not been documented in the planning area but may occur given the available habitats; relatively few focused surveys in the planning area have been conducted to search for these species. The database maintained by Alaska Center for Conservation Science also contains several records of species that occur near the boundary of the planning area: Muir's fleabane (*Erigeron muirii*) and glacier buttercup (*Ranunculus camissonis*).

Nonnative and Invasive Plants

The 2012 IAP/EIS (BLM 2012, Section 3.3.1.3) noted that little was known about non-native and invasive plant species (NNIS) in the planning area, but that the non-native species foxtail barley (*Hordeum jubatum*) and common dandelion (*Taraxacum officinale*) had been recorded north of the crest of the Brooks Range along the Dalton Highway. This information was obtained from the database on invasive plants maintained by the Alaska Exotic Plants Information Clearinghouse (AKEPIC), which is maintained by Alaska Center for Conservation Science. The Alaska Center for Conservation Science has also developed a ranking system to evaluate the potential invasiveness and impacts of non-native plants to natural areas in Alaska (Carlson et al. 2008).

Current information on the AKEPIC website shows an undated record for *H. jubatum* at Umiat, on the eastern boundary of the planning area. The ARCTOS database, maintained by the University of Alaska Museum of the North, includes no records of either *H. jubatum* or *T. officinale* in or near the planning area. Gravel roads provide corridors for the spread of NNIS into new areas, and especially unvegetated areas where weeds can readily establish. Seeds and other propagules can be transported by vehicles and equipment entering the planning area from areas where these species are already established. Given the extent of oilfield development that is occurring at the eastern boundary of the planning area, it is likely that some NNIS have already entered the planning area or will do so in the near future. Another potential NNIS of concern is the aquatic Canadian waterweed (*Elodea canadensis*), which has spread rapidly in recent decades in southcentral and interior Alaska, mainly due to transport of plant parts by boats and floatplanes. Currently, there are no records of this species in the planning area or elsewhere on the North Slope.

Climate Change

Climate change is affecting vegetation and land cover in Arctic Alaska in a variety of ways, including lake and wetland drying, increased thermokarst from permafrost degradation, increased and rapid coastal erosion, changes in plant community species composition and vegetation structure (e.g., shrub expansion), and hydrologic changes influencing riverine systems. These effects are described in detail in Section 3.3.1.4 in the 2012 IAP/EIS. Some North Slope residents (Anaktuvuk Pass and Nuiqsut) have expressed concern that harvests of edible plants, including berries, willow leaves, and rhubarb, are declining in response to climate change (SRB&A Unpublished-b). Others have stated that berries seem more abundant in recent years (SRB&A Unpublished-a). A Nuiqsut resident commented on the tall willows that grow alongside some oilfield roads, attributing their presence to climate change (BLM 2016b).

Recent modeling efforts of the SNAP program have identified the Arctic coastal plain (including the entire program area) as a possible refugium biome, where little to no change in biome composition due to climate change is expected before 2099 (Murphy et al. 2010). The area is, therefore, considered important for conservation of biome characteristics. In addition, the NPR-A is within a zone of a relatively low Normalized Difference Vegetation Index, indicating both low biodiversity and high endemisim of flora and fauna. Areas with a low Normalized Difference Vegetation Index value are projected to be more susceptible to invasion by NNIS.

Coastal erosion was not included in the SNAP modeling exercise due to a lack of comprehensive data sets, but it is an increasing concern in the planning area. The potential for coastal erosion is increasing due to greater storm intensity and wave action, especially in the late fall when sea ice cover is lower than in the past due to warming ocean temperatures. These changes, in combination with permafrost melting at the coast, are allowing coastal erosion to affect permafrost-rich coastal bluffs at a high rate (Jones et al. 2018). The Marine Beach/Beach Meadow land cover type is most likely associated with permafrost-rich coastal bluffs directly exposed to marine nearshore waters and is potentially the most vulnerable land cover type within the planning area. In contrast, the Coastal Marsh type provides protection from coastal erosion via storm and wave action related to climate change.

In inland areas, the freshwater marsh, wet and mesic sedge, mesic herbaceous, and tussock tundra types are the most susceptible to potential wetland drying due to climate change, which may result in a decrease in wildlife habitat function for some species (e.g., waterfowl and shorebirds) and an increase in function for others (landbirds). This could occur with a shift in plant species composition towards more shrub-dominated types and a reduction in the interspersion of open water and vegetation due to wetland drying. Additionally, the milder conditions and longer growing seasons associated with climate change may increase the likelihood that, if NNIS are introduced into the planning area, they can successfully establish and reproduce.

Direct and Indirect Impacts

The effects of climate change described under the *Affected Environment*, above, are part of the baseline conditions for vegetation in the project area. See **Section 3.2.1** for a detailed discussion of the alternatives' contributions to global climate change.

Potential impacts on vegetation were evaluated primarily for those areas available for development under each alternative that also occur within the high development potential zone, where most oil and gas development is likely to occur in the reasonably foreseeable future. Nearly all existing oil and gas lease tracts lie within the high development potential area, and most future leases are also expected to occur there; however, there are two existing oil and gas lease tracts in the medium development potential zone (see **Appendix B**, **Map B-1**). Impacts from activities not related to oil and gas development (e.g., community projects, subsistence activities, and scientific research) could occur in each of the high, medium, and low development potential zones in the reasonably foreseeable future.

The quantification of potential impacts on specific vegetation types using a geographically explicit project footprint (the typical scenario for a proposed development) was not possible for this EIS because no on-the-ground actions have been authorized. Instead, the most vulnerable resources that could be affected were identified by calculating the proportions of each vegetation type occurring in each land-use category within the high development potential zone. The expected total project footprints under the theoretical development scenarios for new oil and gas development are 919 acres, 1,360 acres, and 2,385 acres under the low, medium, and high development scenarios, respectively, as described in **Appendix B**, **Section B.8**. As noted above, much of this development is likely to occur within the high development potential zone in the northeastern portion of the planning area (**Appendix B**, **Map B-1**).

See **Appendix F**, **Section F.4.13** for the analytical concerns related to plant communities in the planning area and the analytical methods used in the analysis of impacts to vegetation presented in the sections below. The effects of climate change, described in the *Affected Environment* section above, could influence the rate or degree of the potential direct and indirect impacts to vegetation.

Alternative A

Under Alternative A, the no action alternative, the decision area would continue to be managed under the 2013 NPR-A ROD, subject to the BMPs and additional protections in biologically sensitive areas listed in **Tables 2-1** and **2-2** in **Chapter 2**. For the purposes of the alternatives analysis, individual management actions have been categorized into management criteria relative to fluid mineral leasing: open to leasing under only standard terms and conditions, NSO, controlled surface use, and closed to leasing. All areas open to leasing may be subject to a set of lease stipulations and ROPs (referred to as BMPs under Alternative A) that permittees would be required to comply with, as detailed in **Table 2-2** in **Chapter 2**. A listing of specific ROPs and lease stipulations that could have impacts on vegetation is provided in **Appendix K, Table K-3**.

The potential impacts on vegetation that could result from management actions in the planning area under Alternative A are described in detail in Section 4.5.5.2 of the 2012 IAP/EIS. The following presents a summary of the potential impacts on vegetation that are likely to continue to occur under Alternative A, as well as some additional information on the potential for the spread of NNIS. Potential impacts are considered separately for the various phases of oil and gas development except that development and production are combined because the potential impacts are similar. These two phases were also combined for the analysis of impacts on vegetation in the 2012 IAP/EIS (Section 4.5.5.2).

As development-related activity increases in the planning area, the potential for invasion by NNIS will also increase. The most likely initial colonizers are foxtail barley (*Hordeum jubatum*) or dandelion (*Taraxacum officinale*), both of which have both been recorded on the North Slope and are ranked as moderately invasive. Additional non-native plants that have been recorded on the North Slope and/or along the Dalton Highway, and could potentially be transported into the planning area via existing or planned roads include lambsquarters (*Chenopodium album*), sticky chickweed (*Cerastium glomeratum*), narrowleaf hawksbeard (*Crepis tectorum*), shepherd's purse (*Capsella bursa-pastoris*), white sweetclover (*Melilotus alba*), and bird vetch (*Vicia cracca*). The latter two species are ranked as highly invasive.

It is possible that the highly invasive aquatic species *Elodea canadensis* could be transported to lakes and rivers in the planning area by boats or floatplanes, as has occurred elsewhere in Alaska. Due to the remoteness of the program area, *Elodea* infestations would be difficult to detect until they were well established. Once established, *Elodea* can dominate aquatic plant communities and displace native species, alter water flow patterns, increase turbidity and pH of the water, and accumulate nutrients while reducing nutrient availability in the substrate (ACCS 2011). Eradication of *Elodea* is challenging, as the species is difficult to control with herbicides, while mechanical methods (e.g., cutting) break up the plants and may promote spread to new areas (Bowmer et al. 1995).

Exploration

Activities associated with the exploration phase that may result in direct and indirect impacts to vegetation include seismic surveys; the construction of ice roads, pads, and airstrips; exploration drilling, and hydrocarbon spills.

Under the Preferred Alternative (B-2) selected in the ROD for the 2012 IAP/EIS, it was estimated that seismic surveys would affect a maximum of 583,000 acres of tundra over the following 30 years (BLM 2012, Section 4.3.5.2). No updates to the area potentially affected by seismic surveys were prepared for this EIS, so the acreage figures from the 2012 IAP/EIS are assumed to apply to all current alternatives. Several studies of tundra affected by previous seismic surveys have indicated that the severity of impacts ranged from low to moderate, with high impacts limited to small areas (BLM 2012, Section 4.3.5.2 and references within). Seismic exploration would occur during winter over the snow-covered tundra surface, with direct surface impacts occurring in a grid pattern caused by heavy, tracked, seismic-vibrator vehicles and the passage of camp trains on skis pulled by a tracked trailer (BLM 2012, Section 4.3.5.2). Direct impacts of seismic tracks on the tundra surface and measurable impacts on vegetation and soils include changes in plant community composition and vegetation structure, altered hydrology, soil compaction, and direct damage to aboveground structures, such as tussocks, woody stems, and branches (Jorgenson et al. 2010; Walker et al. 2019).

Local residents have expressed concern that seismic exploration damages willows along creeks, which may take 30 years or more to recover (BLM 2004f). In a study of seismic trails in the central Arctic coastal plain, vegetation in most sampled plots showed strong recovery after 7 years, and no measurable differences in thaw depth were detected between trail and reference plots (Jorgenson et al. 2003). In contrast, in ANWR, 15 percent of trails made in the mid-1980s were still visible from the air after 14 years (J. Jorgenson, pers. comm., cited in National Research Council 2003). Seismic vehicle traffic in the ANWR resulted in moderate to severe impacts in some tundra types, including tussock tundra and dwarf shrub communities; in some cases, recovery was limited even after 18–25 years (Jorgenson et al. 2010). Techniques of seismic exploration have evolved since the 1980s, and some impacts associated with older methods (e.g., shot holes) no longer occur. However, there has been relatively little change in the equipment and technology used for camp moves, which create some of the most severe and lasting impacts on vegetation associated with seismic exploration (Jorgenson et al. 2010; National Research Council 2003; Walker et al. 2019).

The construction of ice roads, pads, and airstrips during exploration would have direct impacts on vegetation, including compression of the tundra mat, breakage of shrubs, and scuffing or crushing of tussocks (Jorgenson 1999; Pullman et al. 2005; Yokel et al. 2007). Potential indirect impacts include a shortened growing season in the following summer (assuming ice structures remain in place for a single winter) and changes in hydrology caused by melting of the ice. Local residents (Nuiqsut) have stated that ice roads create ponding and crevices, and damage vegetation (BLM 2004d). Both direct and indirect impacts would generally be localized to the areas under and immediately adjacent to the ice structures. Under the Preferred Alternative (B-2) selected in the ROD for the 2012 IAP/EIS (Section 4.3.5.2), it was estimated that short-term disturbance from ice roads, pads, and airstrips might occur on approximately 250,000 acres over a 30-year period. No updates to the area potentially affected by ice roads, pads, and airstrips were prepared for this EIS, so the acreage figures from the 2012 IAP/EIS are assumed to apply to all current alternatives. The severity of impacts and the time required for recovery from the construction and use of ice infrastructure would vary among vegetation types. For example, because of the elevated growth form of *Eriophorum vaginatum* (cottongrass) tussocks, disturbance is likely to be more severe and recovery times longer in tussock tundra than in wet sedge tundra (Pullman et al. 2005, Yokel et al. 2007).

The construction of well cellars during exploration would result in the direct loss of approximately 64 ft^2 of vegetation per well. Indirect impacts could include changes to the thermal regime surrounding the hole, potentially resulting in changes in composition of the vegetation immediately adjacent to the well. The 2012 IAP/EIS estimated that 196 well cellars would be constructed, disturbing a total of 0.3 acres (BLM 2012, Section 4.3.5).

Spills of refined hydrocarbons (e.g., diesel) could occur during exploration activities. These spills would likely be small in volume (less than or equal to 5 gallons), would directly affect small areas (less than or equal to 50 ft^2), and would be cleaned up immediately upon discovery using approved techniques as outlined in the Tundra Treatment Guidelines (Cater 2010) published by the ADEC. The severity of impacts would vary among vegetation types, with wet tundra types generally recovering more quickly than drier areas (Jorgenson 1997; McKendrick 2000).

Development and Production

Activities associated with development and production that may result in direct and/or indirect impacts to vegetation include gravel mining, placement of gravel fill, traffic on gravel roads and the generation of fugitive dust, construction and operation of pipelines, spills, and air pollution.

Gravel mines (material sites) result in direct loss of vegetation in the excavation footprint, and typically also in the footprint of the overburden stockpile. Under Alternative A, BLM considers permit applications for sand and gravel mining throughout the planning area. Based on the projections presented in **Appendix B, Table B-9**, the surface disturbance from gravel mining in the planning area under Alternative A is expected to be 89 acres, 130 acres, or 236 acres for the theoretical low, medium, or high development scenarios, respectively.

Gravel fill would be placed for construction of processing facilities and associated satellite pads, roads, and airstrips. Direct loss of vegetation would occur within the gravel footprint. Based on the projections presented in **Appendix B, Table B-2**, the surface disturbance from gravel fill in the planning area under Alternative A is expected to be 530 acres, 782 acres, or 1,375 acres for the theoretical low, medium, or high development scenarios, respectively.

Placement of gravel fill can also indirectly affect vegetation by altering drainage patterns and locations where snow accumulates. These changes can result in altered hydrology, soil temperature, and thaw depth, and could potentially result in thermokarst. If the salt content of the gravel is elevated, movement of salts into the adjacent tundra may result in indirect impacts on vegetation (McKendrick 2000). Additional indirect impacts from placement of gravel fill may be associated with vehicle traffic and snow removal. Vehicle traffic on gravel roads can result in deposition of dust and gravel on the adjacent tundra, potentially altering habitat characteristics such as the timing of snowmelt, soil moisture and nutrient levels, and thaw depth. These changes may lead to reductions in plant species richness, shifts in species composition, or loss of vegetation. The severity of these effects would depend on the duration and intensity of dust deposition (BLM 2012, Section 4.3.5.2); in addition, some vegetation types would be more sensitive than others. In areas with heavy dust deposition, existing plant communities might be replaced by earlier-successional plants, possibly including NNIS. Vehicle traffic could also contribute to the spread of NNIS by transporting seeds into or within the planning area. Under the Preferred Alternative (B-2) selected in the ROD for the 2012 IAP/EIS, it was estimated that approximately 4,316 acres of vegetation might be subject to heavy dust deposition (“smothering”), and another 17,000 acres would be affected by lighter dust deposition (BLM 2012, Section 4.3.5.2). No updates to the area potentially affected by dust deposition were prepared for this EIS.

Snow dumps, associated with removal of snow from roads and pads, can also indirectly affect adjacent vegetation by altering the length of the growing season and local hydrology. In some cases, entrained gravel and/or debris is also deposited on the adjacent tundra. These indirect effects of the placement of gravel fill are expected to occur within a maximum buffer zone of roughly 328 feet from the edges of gravel roads and pads, based on observed impacts on vegetation from dust deposition, which is the most far reaching of the indirect impact factors noted above (Myers-Smith et al. 2006).

Construction of aboveground oil pipelines results in the direct loss of vegetation due to excavation for vertical support members and placement of the resulting spoil on the adjacent tundra. Changes in the thermal properties of the soil around the vertical support members may result in indirect impacts to vegetation, including changes in hydrology and species composition. Based on the projections presented in **Appendix B, Section B.5**, the surface disturbance from the installation of vertical support members and elevated pipelines in the planning area is expected to be 1 acre, 6 acres, or 10 acres for the theoretical low, medium, or high development scenarios, respectively; these numbers are not broken down by alternative. Aboveground pipelines may also indirectly affect vegetation by altering patterns of snow accumulation, in turn affecting hydrology and length of the growing season; however, Pullman and Lawhead (2002) found that, at most sites under the Alpine and Tarn pipelines, snow accumulation did not differ substantially from nearby reference locations. The 2012 IAP/EIS assumed that, in contrast to oil pipelines, gas pipelines would be buried, resulting in direct loss of vegetation in the trench footprint and indirect impacts to adjacent tundra (BLM 2012, Section 4.3.5.2). This disturbance would be long term, unless rehabilitation treatments were applied (see Abandonment and Reclamation below). Under the Preferred Alternative (B-2) selected in the ROD for the 2012 IAP/EIS, the total area that would be directly impacted by buried gas pipelines was estimated at approximately 1,631 acres (BLM 2012, Section 4.3.5.2). No updates to the area potentially affected by buried gas pipelines were prepared for this EIS, so the acreage figures from the 2012 IAP/EIS are assumed to apply to all current alternatives.

Potential indirect impacts associated with pipelines include spills of crude oil, refined hydrocarbons, produced water, and seawater. As noted above, cleanup and remediation of any spills would be conducted in accordance with the Tundra Treatment Guidelines (Cater 2010). Spills on gravel pads would typically be small and could be cleaned up with minimal impacts. Spills to tundra could be larger, and in some cases might not be detected immediately. The potential impacts from spills range from short-term changes in plant community structure to complete removal of vegetation as part of cleanup operation. Type and severity of impacts that could result from a spill would vary among vegetation types; wetter vegetation types are generally more resilient to spills than dry tundra types. For seawater spills, impacts would be less severe in coastal vegetation types that are adapted to moderate-high salinity, or in wet tundra where the spilled seawater would be dilute. The drier, non-saline tundra types would be most affected by seawater spills.

For specific rivers and streams in the planning area, NSO leasing stipulations define setback buffers (see **Table 2-3** in **Chapter 2**). Under Alternative A, a setback of two miles for the Colville River and variable setback distances for other specific streams are designated; these stream drainage stipulations prohibit surface occupancy and would protect vegetation in those areas. However, exceptions can be made for the construction of essential road and pipeline crossings within stream setbacks. NSO stipulations for deepwater lakes under Alternative A allow for the construction of new infrastructure, but under BMP restrictions; on a case-by-case basis, these stipulations would help protect emergent vegetation along the margins of lakes, which provides high-value habitat for waterbirds.

Abandonment and Reclamation

Activities associated with abandonment and reclamation that could have direct and indirect impacts on vegetation include construction of ice roads, off-road tundra travel, removal of gravel roads and pads, removal of vertical support members and power poles, and application of rehabilitation treatments. The direct impacts of ice road construction and tundra travel would be similar to those described under Exploration. Adverse direct impacts to vegetation could occur during removal of vertical support members and power poles; these impacts would be localized to the immediate vicinity of the structures being removed. The direct impacts of gravel removal and rehabilitation treatments would likely be beneficial, resulting in more rapid vegetation recovery. Potential indirect impacts of gravel removal include changes in the soil thermal regime (leading to altered hydrology) and the introduction of NNIS through contaminated equipment or seed.

The areas open to leasing for fluid minerals under only standard terms and conditions, NSO, and BMPs under Alternative A, as well as the area closed to leasing, are shown in **Table 3-21.** The acreages of each vegetation and land cover class that occur in each of the areas open to fluid mineral leasing under various stipulations and in those areas closed to leasing under Alternative A are listed in **Appendix K**, **Tables K-4** to **K-10** and **K-12** to **K-14**.

Table 3-21
Acreages Open and Closed to Fluid Mineral Leasing by Development Potential Zone Under Alternative A

Lease	Acres Open and Closed to Fluid Mineral Leasing Under Alternative A		
	High Development Potential Zone	Medium Development Potential Zone	Low Development Potential Zone
Total Open	2,065,000	5,758,000	3,938,000
Standard terms and conditions	1,428,000	4,595,000	3,247,000
NSO	637,000	1,163,000	691,000
Closed	1,516,000	1,926,000	7,550,000

Community Infrastructure, Scientific, and Subsistence Activities

Impacts from activities not related to oil and gas development are summarized in the 2012 IAP/EIS (BLM 2012, Section 4.3.5.1). Typically smaller in scope, these activities include the use of off-road vehicles (wheeled or tracked), cleanup activities at former defense sites, overland moves between communities, scientific research camps, archeological digs, off-runway landings, and new community infrastructure (e.g., gravel roads and pads). Though of reduced magnitude, all these activities could have adverse direct and indirect effects similar in nature to those described above for oil and gas development. Overland vehicle traffic has the potential to disturb vegetation types dominated by tussocks in a similar manner to seismic exploration. Cleanup activities, scientific research camps, archeological digs, and new community infrastructure would involve surface disturbance activities that could remove vegetation and alter plant communities. These impacts would range from temporary (cleanup sites) to permanent (new community infrastructure) depending on the extent and duration of the activities. Some of these non-oil and gas activities may occur in the high development potential zone in the northeastern portion of the planning area where most oil and gas development is likely to occur, but they may also occur in the medium and low development potential zones. The proposed community road from Nuiqsut to Utqiaġvik, for example, would occur partially in the high development potential zone, but would continue west and north to Utqiaġvik in the medium development potential zone.

Impacts Common to All Action Alternatives

The impacts related to oil and gas exploration and development activities, which were discussed under Alternative A, would also occur for each of the action alternatives. As discussed below, the primary differences between Alternative A and the action alternatives are in the areas that would be made available for leasing and the areal coverage of the various leasing stipulations for each action alternative. Potential impacts from non-oil and gas activities, including community infrastructure, scientific, and subsistence activities, are expected to be similar to those under Alternative A for all action alternatives.

Additionally, a number of specific procedures that could result in or minimize impacts on vegetation would apply for all the action alternatives; these include:

- As designated under Alternative A, the arctic peregrine falcon nesting habitat protections associated with the Colville River Special Area (which would provide protections for vegetation in the vicinity or raptor nests), have been applied to all nesting raptors under the base-level ROPs; the ROPs applicable to nesting raptors now apply throughout the entire planning area in the vicinity of active raptor nests.
- NSO stipulations for rivers and streams would prohibit the development of new infrastructure within specific setback distances (which vary among the action alternatives; see below); exceptions would be made for essential road and pipeline crossings.
- Community infrastructure projects may be permitted (with appropriate mitigation) in areas closed to oil and gas leasing and development.
- Non-oil and gas activities include (but are not limited to) scientific use permits, sand and gravel mining, and recreational permits.
- Permit applications for sand and gravel mining would be considered throughout the planning area (the same as under Alternative A), with the exception of a 3-mile setback along a portion Fish Creek.
- In the Pik Dunes BSA, operators would be required to conduct a plant survey prior to constructing an ice pad, and to avoid construction where special status plant species are identified. No such requirement applies under Alternative A.

Alternative B

Those areas that are closed to oil and gas leasing under Alternative A would remain closed under Alternative B, and overall more area would be closed to oil and gas leasing (and new infrastructure) under Alternative B (**Appendix K, Tables K-12** to **K-14**). Within the high and medium development potential zones, the total acres available for fluid mineral leasing would be less than under Alternative A, while the area open to leasing within the low potential zone would be slightly greater (**Table 3-22**). Under Alternative B, the Teshekpuk Lake Special Area would be bisected by two north-south trending corridors that would be made available for pipeline construction. The NSO stipulations specify a setback of 7 miles for the Colville River and variable setback distances for other specific streams, which would protect vegetation in those buffer zones. As under Alternative A, exceptions can be made for the construction of essential road and pipeline crossings within stream setbacks. NSO stipulations for deepwater lakes under Alternative B prohibit the construction of any new infrastructure in buffer zones around those waterbodies, which would protect emergent vegetation along the margins of lakes (that provides high-value habitat for waterbirds) as well as protect adjacent tundra vegetation.

The areas open to leasing for fluid minerals under only standard terms and conditions, areas with NSO, and areas closed to leasing under Alternative B are shown in **Table 3-22.** The acreages of each vegetation and land cover class that occur in each of the areas open to fluid mineral leasing under various stipulations and in those areas closed to leasing under Alternative B are listed in **Appendix K, Tables K-5** to **K-10** and **K-12** to **K-14**.

Table 3-22
Acreages Open and Closed to Fluid Mineral Leasing by Development Potential Zone Under Alternative B

Lease	Acres Open and Closed to Fluid Mineral Leasing Under Alternative B		
	High Development Potential Zone	Medium Development Potential Zone	Low Development Potential Zone
Total Open	1,856,000	5,419,000	4,147,000
Standard terms and conditions	1,094,000	3,794,000	2,743,000
NSO	762,000	1,625,000	1,404,000
Closed	1,725,000	2,266,000	7,341,000

Based on the projections presented in **Appendix B**, **Table B-9**, the surface disturbance from gravel mining in the planning area under Alternative B is expected to be 80 acres, 117 acres, or 212 acres for the theoretical low, medium, or high development scenarios, respectively. Similarly, the surface disturbance from gravel fill in the planning area under Alternative B is expected to be 476 acres, 703 acres, or 1,236 acres for the theoretical low, medium, or high development scenarios, respectively.

Alternative C

Under Alternative C, the acres available for leasing within the high and medium development potential zones would be greater than under Alternative A, while the open area within the low potential zone would be smaller. The Teshekpuk Lake Special Area would be reduced in size but would retain a core area closed to leasing and new infrastructure. A single north-south pipeline corridor would be located within the reduced Teshekpuk Lake Special Area. Lease stipulations and ROPs would be adjusted to allow leasing and new infrastructure within the Teshekpuk Lake Special Area (outside of the core area).

Relative to Alternative A, Alternative C represents a 19 percent increase in lands available for leasing and thus potentially subject to the permanent loss of vegetation. Timing limitations would have no effects (positive or negative) on the protection of vegetation. NSO stipulations would prohibit any surface occupancy and thus would protect vegetation in its natural state, with the exception of essential road and pipeline crossings of specific stream drainages. In contrast to Alternative A, leasing would be allowed under Alternative C in the Pik Dunes area but with NSO restrictions. The NSO stipulations specify a setback of 3 miles for the Colville River and variable setback distances for other specific streams, which would protect vegetation in those buffer zones. As under Alternative A, exceptions can be made for the construction of essential road and pipeline crossings within stream setbacks. NSO stipulations for the buffer zones around deep-water lakes under Alternative C allow for the construction of new infrastructure, but under ROP restrictions. On a case-by-case basis, these stipulations would help protect emergent vegetation along the margins of lakes (which provides high-value habitat for waterbirds) as well as help protect adjacent tundra vegetation.

The areas open to leasing for fluid minerals under only standard terms and conditions, NSO, and timing limitations under Alternative C, as well as the area closed to leasing, are shown in **Table 3-23.** The acreages of each vegetation and land cover class that occur in each of the areas open to fluid mineral leasing under various conditions and in those areas closed to leasing under Alternative C are listed in **Appendix K, Tables K-5** to **K-10** and **K-12** to **K-14**. No table is provided for acreages subject to timing limitations, which are not expected to affect impacts on vegetation and wetlands.

Table 3-23
Acreages Open and Closed to Fluid Mineral Leasing by Development Potential Zone Under Alternative C

Lease	Acres Open and Closed to Fluid Mineral Leasing Under Alternative C		
	High Development Potential Zone	Medium Development Potential Zone	Low Development Potential Zone
Total Open	2,606,000	7,384,000	7,062,000
Standard terms and conditions	1,394,000	4,352,000	5,678,000
NSO	1,015,000	2,603,000	1,384,000
Timing limitations	197,000	429,000	0
Closed	974,000	300,000	4,427,000

Based on the projections presented in **Appendix B**, **Table B-9**, the surface disturbance from gravel mining in the planning area under Alternative C is expected to be 112 acres, 164 acres, or 297 acres for the theoretical low, medium, or high development scenarios, respectively. Similarly, the surface disturbance from gravel fill in the planning area under Alternative C is expected to be 669 acres, 987 acres, or 1,736 acres for the theoretical low, medium, or high development scenarios, respectively.

Alternative D

Under Alternative D, the acres available for leasing within all three development potential zones (high, medium, and low) would be greater than under Alternative A. All lands in the Teshekpuk Lake Special Area would be open for leasing, though with NSO, timing limitation, and controlled surface use stipulations. Under Alternative D, the total area open for leasing (including the area subject to NSO, timing limitation, and controlled surface use lease stipulations) encompasses the entire high development potential zone at 3,581,000 acres. This represents a 50 percent increase over Alternative A. Timing limitations would have no effects (positive or negative) on the protection of vegetation. NSO stipulations would prohibit any surface occupancy and thus would protect vegetation in its natural state, with the exception of essential road and pipeline crossings of specific stream drainages.

In contrast to Alternative A, leasing would be allowed under Alternative D in the Pik Dunes area but with NSO restrictions. NSO stipulations under Alternative D for specific rivers and streams and for deepwater lakes are the same as those under Alternative C. Stipulations for controlled surface use allow for some surface occupancy and use for development, but constraints on operations would be enacted for sensitive or special resources. Under Alternative D, the controlled surface use sensitive resources stipulations for goose molting areas (K-6 Goose Molting Area) and brant nesting colonies (K-8 Brant Survey Area) would allow for new infrastructure but only under specific ROPs. On a case-by-case basis, these controlled surface use stipulations would help protect vegetation resources in areas used by molting geese and nesting brant.

The areas open to leasing for fluid minerals under only standard terms and conditions, NSO, timing limitations, and controlled surface use under Alternative D, as well as the area closed to leasing, are shown in **Table 3-24.** The acreages of each vegetation and land cover class that occur in each of the areas open to fluid mineral leasing under various conditions and in those areas closed to leasing under Alternative D are listed in **Appendix K**, **Tables K-5** to **K-11**, **K-13**, and **K-14**. No table is provided for acreages subject to timing limitations, which are not expected to affect impacts on vegetation and wetlands.

Table 3-24
Acreages Open and Closed to Fluid Mineral Leasing by Development Potential Zone Under Alternative D

Lease	Acres Open and Closed to Fluid Mineral Leasing Under Alternative D		
	High Development Potential Zone	Medium Development Potential Zone	Low Development Potential Zone
Total Open	3,581,000	7,680,000	7,062,000
Standard terms and conditions	1,402,000	4,722,000	5,946,000
NSO	1,429,000	2,108,000	1,116,000
Timing limitations	563,000	599,000	0
Controlled surface use	187,000	251,000	0
Closed	0	3,000	4,427,000

Based on the projections presented in **Appendix B**, **Table B-9**, the surface disturbance from gravel mining in the planning area under Alternative D is expected to be 154 acres, 225 acres, or 409 acres for the theoretical low, medium, or high development scenarios, respectively. Similarly, the surface disturbance from gravel fill in the planning area under Alternative D is expected to be 919 acres, 1,356 acres, or 2,385 acres for the theoretical low, medium, or high development scenarios, respectively.

Cumulative Impacts

The geographic area considered for cumulative impacts on vegetation encompasses the entire North Slope of Alaska, including the north slope of the Brooks Range, foothills, and the Arctic Coastal Plain. This area was selected because it is projected to be a refugium (i.e., resisting biome change due to climate change) through the year 2099 (Murphy et al. 2010). The time frame for the analysis begins in the 1970s, includes all past and present (existing) developments on the North Slope, and extends forward 70 years after the signing of the ROD for this EIS. Past and present projects within the planning area, and thus managed under the existing 2012 IAP/EIS (BLM 2012), were discussed briefly in the *Affected Environment* section above.

Cumulative effects on vegetation from development and land-use activities in the past, present, and reasonably foreseeable future include construction and maintenance of ROWs, transportation, infrastructure, continued and new mining and oil and gas operations, recreational uses, subsistence uses, military projects, as well as natural events (such as wildfire, flooding, permafrost degradation, and changes in climate). The upcoming GMT2, Willow, and Nanushuk projects; the Alaska Liquefied Natural Gas (LNG) project; Alaska Stand Alone Pipeline project; and seismic exploration surveys would have impacts as described for oil and gas developments above. When combined with the alternatives discussed in this EIS, these actions or events occurring in the planning area could affect vegetation in ways similar to the impacts described above and in the 2012 IAP/EIS (BLM 2012, Section 4.7.7.5). The effects of climate change described under *Affected Environment*, above, could influence the rate or degree of the potential cumulative impacts.

In more remote areas, natural events (e.g., floods, wildfires, permafrost degradation, avalanches, freeze/thaw dynamics, insect and disease outbreaks, alterations in wildlife behavior, and changes in climate) would have the greatest effects on vegetation, while areas near existing or future developments would be at a greater risk for anthropogenic impacts (e.g., infrastructure development, spread of NNIS, fluid and locatable mineral mining, and recreation). The contribution to cumulative impacts from these types of anthropogenic actions would be reduced through future environmental compliance requirements (NEPA, Clean Water Act, Endangered Species Act (ESA) at the local leasing or project design levels. However, due to the sensitivity of vegetation and plant communities and the low overall human-disturbance levels in the planning area, most projects are likely to contribute to adverse cumulative effects on vegetation. This is especially true for impacts to rare plants and sensitive landscape features such as sand dunes, permafrost soils, and wetlands (see also **Section 3.3.2**, Wetlands and Floodplains).

Cumulative impacts would potentially occur under all proposed action alternatives. Alternative D would result in the greatest contribution to cumulative impacts and Alternative B the least, based on land areas available for leasing, specific leasing stipulations, RFD scenarios, and the protections provided in the Teshekpuk Lake Special Area, which vary among the action alternatives.

In addition to those projects under current operations on the Arctic Coastal Plain, the upcoming GMT2 and Willow projects represent similar oil and gas developments in the reasonably foreseeable future and both are within the management boundaries of the planning area. Beyond the boundaries of the planning area, the Kuparuk River field, the Greater Prudhoe Bay/Deadhorse Area, and the Point Thomson field are all operational and are likely to continue to contribute additive, direct, and indirect effects of oil and gas development, as described in the *Impacts Common to All Action Alternatives* section above. RFFAs in the cumulative impacts analysis area include the Nanushuk project, Alaska LNG project, Alaska Stand Alone Pipeline project, and the SAE 3D seismic survey in the ANWR. In addition to the larger oil and gas projects, there are existing and reasonably foreseeable community infrastructure projects, scientific research camps, and subsistence impacts, as described in the *Community Infrastructure, Scientific, and Subsistence Activities* and *Impacts Common to All Action Alternatives* sections above.

Comprehensive mapping data are not available for all the RFFAs to facilitate a meaningful quantitative analysis of the cumulative loss of vegetation; however, all listed developments will contribute additive impacts to existing and proposed developments within the planning area. While most direct effects constitute a permanent loss or alteration of vegetation resources, the most concerning cumulative effects may be the loss of specific high-value habitats, such as those in the Teshekpuk Lake area (high-value for wildlife) or the Pik Dunes (high-value for plant communities with rare species). Regardless of what high-value areas are identified and protected, climate change will also contribute to cumulative impacts, in the form of altered vegetation and wildlife habitats across the entire coastal plain, as described in the *Affected Environment* section above.

3.3.2 Wetlands and Floodplains

Affected Environment

Wetland and Waters of the U.S.: Definition, Jurisdiction, and Permitting

Wetlands are defined by the U.S. Army Corps of Engineers and the EPA to determine jurisdiction under Section 404 of the Clean Water Act. The U.S. Army Corps of Engineers provides technical manuals to identify wetlands according to a three-parameter system based on the presence of hydrophytic vegetation, hydric soils, and wetland hydrology (Environmental Laboratory 1987, USACE 2007a). Waters are determined as jurisdictional under Section 404 of the Clean Water Act and Section 10 of the Rivers and Harbors Act depending on navigability, and are identified based on connectivity to the nearest Navigable Water (USACE 2007b). Jurisdictional wetlands and waters are subject to permitting if a proposed project will result in permanent loss due to placement of fill. The majority of the planning area (97 percent) is expected to be wetlands or waters of the U.S. based on information from the U.S. Fish and Wildlife Service (USFWS) National Wetland Inventory program (BLM 2012, USFWS 2019). The National Wetland Inventory mapping represents a broad-scale delineation of wetlands on the landscape prepared using aerial photo-interpretation and assumes that the entire North Slope is composed of contiguous, jurisdictional wetlands. The National Wetland Inventory mapping, however, is only available for a small portion of the planning area. In finer scale wetland mapping based on local field survey data, specific areas of non-jurisdictional uplands in the planning area may be identified and delineated.

Description and Distribution of Wetlands

Digital wetland mapping is not available for the entire planning area, so the recent NSSI land cover map (Ducks Unlimited 2013) was used as the basis for acreage calculations of wetland types in this EIS. The mapped types (vegetation classes and corresponding wetland classes) are described in **Table K-1** in **Appendix K**; this includes the 21 vegetation types that occur in the planning area. For the purposes of evaluating wetlands and waters, a crosswalk was developed between mapped vegetation types, equivalent National Wetland Inventory types known to occur on the North Slope, and broad-scale wetland types (**Table K-2** in **Appendix K**). Wetland types were assigned to most vegetation classes based on the assumption that wetlands are widespread in the area. A few types were assigned upland status based on recent work comparing vegetation classes to wetland determination field plots for the proposed Willow development in the planning area (Wells et al. 2018). The crosswalk is conservatively biased towards wetlands and it is possible that some wetland classes may include patches of uplands.

The planning area includes 1 water type and 4 broad-scale wetland types (**Table 3-20**), which represent marine, estuarine, lacustrine, and freshwater systems according to the standard U.S. Army Corps of Engineers wetland classification method (FGDC 2013). Areas mapped as Open Water in the NSSI map include nearshore and marine saltwater, lentic waters (lakes [less than 20 acres], ponds [greater than 20 acres]) and lotic waters (lower perennial rivers and streams and tidal rivers). Open Water as a whole accounts for 2,358,000 acres or 10 percent of the total planning area, with the majority of that likely to be lentic waters in the form of numerous lakes and ponds forming in thaw basins throughout the area. Lotic waters are typically small, meandering, slow-moving, and low-gradient freshwater streams, but they also include broad, braided, tidally influenced rivers in the Colville River and Fish Creek deltas.

The Freshwater Emergent wetland type includes a range of vegetation classes from permanently flooded aquatic marshes, semi-permanently flooded sedge meadows, and continuously or seasonally saturated mesic herbaceous, and mesic herbaceous/shrub tundra. The most abundant vegetation classes within the Freshwater Emergent type are Tussock Shrub Tundra (7,584,000 acres, 33 percent of the planning area) and Tussock Tundra (5,009,000 acres, 22 percent of the planning area) (**Table 3-20**). These vegetation classes dominate the majority of the gently sloping terrain occurring between lake basins on the Arctic Coastal Plain and on lower slopes in the Brooks Range foothills. As noted in **Table K-1** in **Appendix K**, the tussock tundra types are dominated by tussocks formed by the sedge *Eriophorum vaginatum,* with a variety of co-dominant herbaceous and low shrub species. The tussock tundra types are likely to be underlain by permafrost and maintain at least a continuously saturated hydrologic regime throughout the growing season, but may, in some cases, be well-drained uplands. The Wet Sedge vegetation type also accounts for a major proportion of the Freshwater Emergent wetland type (2,741,000 acres, 12 percent of the planning area) (**Table 3-20**). Wet Sedge is dominated by obligate wetland sedges and typically has surface water throughout the growing season; it is very likely to be underlain by permafrost and is the dominant vegetation type in poorly drained, depressional lake basins on the Arctic Coastal Plain.

The Freshwater Shrub wetland type accounts for 1,942,000 or 8 percent of the planning area (**Table 3-20**). Shrub wetlands range from dwarf-shrub dominated communities to tall willow. Shrub-dominated wetlands are relatively rare and tend to occupy well-drained areas such as raised ridges, bluffs, or seasonally flooded riverbanks. Hydrology may be continuously saturated or subject to seasonal floods due to snowmelt or rain events. Upland inclusions are likely within this class due to the wide range of landscape positions that Freshwater Shrub wetlands occur in.

The vegetation types determined most likely to be non-jurisdictional uplands are *Dryas* Dwarf Shrub, Bare Ground, and Sparsely Vegetated; combined, these types account for 3 percent of the entire planning area) (**Table 3-20**). *Dryas* Dwarf Shrub occurs on raised riverbanks or bluffs at the edges of lake basins. Soils are well drained and dry throughout the growing season. Bare Ground and Sparse Vegetation occur in limited areas of well-drained eolian sand deposits and abandoned riverine deposits. Bare Ground may also include fill from existing roads and pads associated with both oil and gas and community development projects. The past and present developments that would contribute to upland fill in the planning area include the Alpine, Colville Delta-5, and GMT1 projects; however, the mapping used for this analysis may not include those new developments due to the age of the baseline imagery used in the mapping prepared by Ducks Unlimited (2013).

Wetland Functions and Values

Despite a short growing season, cold soil conditions, and a harsh winter climate, wetlands in the planning area support a variety of functions including discharge and recharge of supra-permafrost groundwater that maintains wetland health; distribution or retention of sediments, nutrients, and toxicants; net primary production and nutrient export; habitat for wildlife; and flood attenuation and storage in floodplain wetlands (BLM 2012). Freshwater Emergent wetland types include both sedge and grass marsh classes, and wet sedge meadows that are important bird habitats. While they are relatively low in plant diversity and hydrologic functions, poorly drained wetlands provide important feeding, nesting, and brood-rearing habitat for a range of bird species, especially waterbirds and shorebirds.

As noted above, the most common vegetation types within the Freshwater Emergent wetland class are the tussock and wet tundra types. These are the most commonly occurring wetlands in the planning area, and they may have the highest plant diversity; they also provide high-value wildlife habitat in areas where surface water is present. Freshwater Shrub wetlands provide important wetland functions in riparian landscape positions. Specifically, they function at a high level for organic matter input, flood attenuation, and erosion control, and they provide unique wildlife habitats on the Arctic Coastal Plain due to the elevated shrub canopy.

Climate Change

Climate change is affecting wetlands and waters of the U.S. in Arctic Alaska in a variety of ways, which includes lake and wetland drying, increased thermokarst from permafrost degradation, increased and rapid coastal erosion, changes in plant community species composition and vegetation structure (e.g., shrub expansion), and hydrologic changes influencing riverine systems. These effects are described in detail in Section 3.3.1.4 in the 2012 Final IAP/EIS (BLM 2012). The Arctic coastal plain (including the entire planning area) has been identified as a possible refugia through recent modeling efforts of the SNAP program. The entire coastal plain is predicted to have little to no change in biome composition before 2099 and is thus considered an important area for conservation (Murphy et al. 2010). In addition to preserving biome characteristics, the NPR-A is within a zone of relatively low Normalized Difference Vegetation Index value, which indicates both low biodiversity and high endemisim of flora and fauna in the area. Areas with low Normalized Difference Vegetation Index value are projected to be more susceptible to invasion by NNIS (Murphy et al. 2010).

Coastal erosion was not included in the SNAP modeling exercise due to a lack of comprehensive datasets, but it is an increasing problem in the planning area and is being exacerbated by increased storm intensity and wave action, especially in the late fall with reduced sea ice due to warming ocean temperatures. This, in combination with permafrost melting at the coast, is allowing coastal erosion to affect permafrost-rich coastal bluffs at a high rate (Jones et al. 2018). The wetland type, Marine Intertidal (beaches), is most likely associated with permafrost-rich coastal bluffs directly exposed to marine nearshore waters and is potentially the most vulnerable waters type within the planning area. In contrast, the Estuarine Intertidal Vegetated type (saltmarsh) provides protection from coastal erosion via storm and wave action related to climate change. In inland areas, Freshwater Emergent wetlands are the most susceptible to wetland drying climate impacts, which may result in a decrease in wildlife habitat function for some species (e.g., waterfowl and shorebirds) and an increase in function for others (landbirds). This could occur with a shift in plant species composition towards more shrub-dominated types and a reduction in the interspersion of open water and vegetation due to wetland drying.

Direct and Indirect Impacts

The effects of climate change described under the *Affected Environment*, above, are part of the baseline conditions for wetlands and floodplains in the project area. See **Section 3.2.1** for a detailed discussion of the alternatives' contributions to global climate change.

Potential impacts on wetlands in this section were evaluated primarily for those areas available for development under each alternative that also occur within the high development potential zone, which is where most oil and gas development is likely to occur in the reasonably foreseeable future (**Map B-1** in **Appendix B**). Nearly all existing oil and gas lease tracts lie within the high development potential area, and most future leases are also expected to occur there; however, there are two existing oil and gas lease tracts in the medium development potential zone (see **Appendix B**, **Map B-1**). Impacts from activities not related to oil and gas development (e.g., community projects, subsistence activities, and scientific research) could also occur in each of the high, medium, and low development potential zones in the reasonably foreseeable future.

The quantification of potential impacts on specific wetland types using a geographically explicit project footprint (the typical scenario for a proposed development) was not possible for this EIS because no on-the-ground actions have been authorized. Instead, the most vulnerable resources that could be affected were identified by calculating the proportions of each wetland type occurring in each land-use category within the high development potential zone. The expected total project footprints under the theoretical development scenarios for new oil and gas development are 919 acres, 1,360 acres, and 2,385 acres under the low, medium, and high development scenarios, respectively, as described in **Section B.8**, **Appendix B**. As noted above, much of this oil and gas-specific development is likely to occur within the high development potential zone in the northeastern portion of the planning area (**Map B-1** in **Appendix B**); non-oil and gas impacts are more likely to occur throughout the entire planning area, including the medium and low development potential areas.

See **Appendix F** for the analytical concerns related to the wetland types in the planning area and the analytical methods used in the analysis of impacts to wetlands presented in the sections below. The effects of climate change, described in the *Affected Environment* section above, could influence the rate or degree of the potential direct and indirect impacts to wetlands.

Alternative A

Alternative A is the no action alternative, under which lands in the decision area would continue to be managed under the 2013 NPR-A IAP/EIS ROD, subject to the BMPs and additional protections in biologically sensitive areas listed in **Tables 2-1** and **2-2** in **Chapter 2**. For the purposes of the alternative analysis, individual management actions have been categorized into management criteria, which include areas closed to fluid mineral leasing, open under standard terms and conditions, NSO, and controlled surface use. Standard terms and conditions are controlled by a set of BMPs and lease stipulations under Alternative A and by ROPs and lease stipulations under all other action alternatives. A listing of specific ROPs and lease stipulations that affect the health of wetlands and waters is provided in **Table K-3** in **Appendix K**.

The most beneficial actions that preserve wetlands in their natural state are those that prohibit any type of development; thus, the highest level of protection for wetlands are those lands that are subject to no fluid mineral leasing. Under Alternative A, 1,516,000 acres are closed to leasing and are located primarily in the Teshekpuk Lake Special Area within the high development potential zone (**Table K-13** in **Appendix K**; **Map 2-10** in **Appendix A**). Under Alternative A, the majority of the Teshekpuk Lake Special Area is closed to fluid mineral leasing.

The Colville River Special Area is closed to fluid mineral leasing in the headwaters of the Colville River within the low and medium development potential areas. BMP K-12 (**Table 2-1**, **Chapter 2**) applies to areas not available for leasing in the Colville River Special Area and provides protection for ponds, lakes, wetlands, and riparian areas within 15 miles of known raptor nests, which provides additional protection for specific high value wetland habitats. The remainder of the Colville River Special Area generally protects wetlands and waters under NSO management conditions, although permanent facilities can be permitted if there are no other practicable options and essential road and pipeline crossings would be considered on a case-by-case basis (**Table 2-2** in **Chapter 2**). Exceptions would be made in three designated stream confluence locations in which surface occupancy is not allowed, but essential road and pipeline crossings would be considered on a case-by-case basis in those areas (**Table 2-2** in **Chapter 2**).

Areas closed to fluid mineral leasing throughout the entire decision area are concentrated in the low development potential area with a maximum of 7,550,000 acres under Alternative A (**Table K-15**, **Appendix K**). While areas closed to leasing in the high development area are considered to be the highest level of protection for wetlands, these stipulations may not be as protective in the medium and low development potential areas where non-oil and gas activities are more likely to be the dominant impacts.

The most common wetlands occurring in the planning area are the Freshwater Emergent types corresponding to Tussock Tundra and Tussock Shrub Tundra, which combined, account for 55 percent of the total area (**Table 3-20**). In the areas closed to leasing in the high development potential zone, some of the less well-drained wetland types occur in greater proportions than in the planning area. For example, Freshwater Emergent/Wet Sedge and Freshwater Emergent/Fresh Water Marsh (*Carex aquatilis*) represent 23 percent and 20 percent, respectively, of the areas closed to leasing in the high development potential area (**Table K-13**, **Appendix K**), which compares with 12 percent and 8 percent, respectively, in the planning area (**Table 3-20**). These wetter habitats, which are preferentially protected in the areas closed to leasing in the high development potential area under Alternative A, provide suitable habitats for breeding waterbirds and shorebirds and therefore higher value wetlands. In contrast to areas closed to leasing in the medium and low development potential areas, the most common wetland types preserved are the Freshwater Emergent/Tussock Tundra and Freshwater Emergent Tussock Shrub Tundra (**Tables K-14** and **K-15**,

Appendix K), which are generally considered lower value wetlands than the wetter types that dominate the high development potential zone.

A total of 635,000 acres are open to fluid mineral leasing under NSO stipulations in the high development potential area (**Table K-7**, **Appendix K**), which are primarily located within buffers along rivers and streams, surrounding deepwater lakes, and in coastal areas. For specific rivers and streams in the planning area, NSO stipulations define setback buffers (see **Table 2-3** in **Chapter 2**). Under Alternative A, a setback of two miles for the Colville River and variable setback distances for other specific streams are designated; these stream drainage stipulations prohibit surface occupancy within setback buffers and would protect wetlands and waters in those areas. However, exceptions can be made for the construction of essential road and pipeline crossings within stream setbacks. Development of roads and pipelines in NSO areas is permitted based on individual review, which may allow for avoidance and minimization measures to be implemented, which could protect higher value wetland habitat. Prior wetland mapping and functional assessments are not required under BMPs, but they would help facilitate avoidance and minimization planning as well as the development of mitigation measures.

Lease stipulation E-2 under NSO management conditions protects lacustrine fringe wetlands by restricting construction within 500 feet of fish-bearing waters. Additionally, BMP K-12 provides protection for wetlands within one-fourth mile of ordinary high water on deepwater lakes within the areas closed to leasing. Considered on a case-by-case basis, these stipulations and BMPs would help protect wetland marshes along the margins of lakes, which provide high-value wetland habitat for waterbirds, as well as help protect adjacent wetlands.

The potential impacts to wetlands that could result from management actions in the planning area under Alternative A are described in detail in the Section 2.3.5 of the 2012 IAP/EIS (BLM 2012). This section presents a summary of the potential impacts to wetlands that are likely to continue to occur under Alternative A. Potential impacts are considered separately for the various phases of oil and gas development except that development and production are combined because the potential impacts are similar. These two phases were also combined for analysis in Section 4.3.6 of the 2012 IAP/EIS (BLM 2012).

Oil and Gas Exploration

Seismic surveys may occur under all alternatives, with potentially adverse effects on wetlands across all areas open for lease. Much of the planning area has already been assessed with 2-D seismic surveys, and future 3-D surveys are expected primarily in lease-blocks to collect additional data on promising areas (**Appendix B**, **Section B.3**). Seismic exploration would occur during winter over the snow-covered tundra surface, with direct surface impacts occurring in a grid pattern caused by heavy, tracked, seismic-vibrator vehicles and the passage of camp trains on skis pulled by a tracked trailer (Table 2-3; BLM 2012). Direct impacts are visible on the tundra surface, and measurable impacts on vegetation and wetlands include changes in plant community composition and vegetation structure, altered hydrology, compaction of soil, and direct damage to aboveground structures, such as tussocks, woody stems, and branches (Jorgenson et al. 2010; Walker et al. 2019).

Long-term studies have shown that the overall impacts of seismic vehicle traffic on tundra are low, but impacts can still be measured up to 33 years after exploration (Jorgenson et al. 2003; Jorgenson et al. 2010). In a study of seismic trails in the central Arctic coastal plain, vegetation in most sampled plots showed strong recovery after 7 years, and no measurable differences in thaw depth were detected between trail and reference plots (Jorgenson et al. 2003). In contrast, in the ANWR, 15 percent of trails made in the mid-1980s were still visible from the air after 14 years.[4] Seismic vehicle traffic in the ANWR resulted in moderate to severe impacts in some wetland types, especially the Freshwater Emergent types corresponding to the Tussock Shrub Tundra and Dwarf Shrub vegetation types; in some cases recovery was limited even after 18–25 years (Jorgenson et al. 2010). Techniques of seismic exploration have evolved since the 1980s, and some impacts associated with older methods (e.g., shot holes) no longer occur; however, there has been relatively little change in the equipment and technology used for camp moves, which create some of the most severe and lasting impacts on tundra wetlands associated with seismic exploration (Jorgenson et al. 2010; National Research Council 2003; Walker et al. 2019).

Seismic vibrator lines and camp train trails on the North Slope may be visible during the summer months as a grid of green tundra that supports a higher cover of graminoid species than the surrounding undisturbed tundra, and in the winter as troughs that accumulate snow in the microtopographic depressions created by the passage of heavy vehicles. As noted above, the most susceptible wetlands were the Freshwater Emergent types corresponding to the Tussock Shrub Tundra and Dwarf Shrub vegetation types. The long-term damage to wetlands caused by seismic exploration has the potential to reduce wetland function by reducing plant species diversity, altering wildlife habitats, and changing the soil thermal regime. The typically higher value wetlands with wetter hydrologic regimes exhibit few long-term effects from winter seismic surveys because of the heavier snow and ice cover and the lack of vulnerable tussocks and elevated woody vegetation.

Across the entire planning area, the most commonly occurring wetlands types (Freshwater Emergent/Tussock Tundra and Freshwater Emergent/Tussock Shrub Tundra) are the most vulnerable to seismic disturbances. In addition, these types are most likely to occur in inland settings where much of the area open to leasing under standard terms and conditions is located for all alternatives. Under the Preferred Alternative (B-2) selected in the ROD for the 2012 IAP/EIS Table 2-2, it was estimated that seismic surveys would affect a maximum of 583,000 acres of tundra over the following 30 years (Section 4.5.5.2 in BLM 2012). No updates to the area potentially affected by seismic surveys were prepared for this EIS, so the acreage figures from the 2012 IAP/EIS are assumed to apply to all current alternatives.

Ice roads are built during the winter months during the exploration phase to access drill pads. Adverse effects may be expected within the more well-drained, but saturated wetlands or wetlands dominated by low or dwarf shrub vegetation (e.g., Freshwater Emergent and Freshwater Shrub wetlands corresponding to Tussock Tundra, Dwarf Shrub, Birch Ericaceous Low Shrub, and Low-Tall Willow) (**Table K-1** in **Appendix K**). Wetlands with semi-permanently flooded or permanently flooded hydrologic regimes may experience few lasting effects. The damage from ice roads was found to be due to the freezing of plant tissues in ice (in those species not adapted to inundation in water and ice), as well as the clipping of high microsites, such as raised tussocks that form in tussock tundra or shrub branches in low shrub vegetation types (Guyer and Keating 2005). Compaction of the soil and surface organic layers is also a potential effect of ice-road construction. Effects are most prominent in the period of 0 to 5 years from disturbance and vegetation largely recovers after 20 years. The most obvious adverse effect of ice roads is the alteration of the vegetation canopy, which would result in some loss of wildlife habitat value in those wetlands that receive the greatest damage. Under the Preferred Alternative (B-2) selected in the ROD for the 2012 IAP/EIS Table 2-2, it was estimated that short-term disturbance from ice roads, pads, and airstrips might occur on approximately 250,000 acres over a 30-year period (Section 4.5.5.2 in BLM 2012). No updates to the area potentially affected by ice roads, pads, and airstrips were prepared for this EIS, so the acreage figures from the 2012 IAP/EIS are assumed to apply to all current alternatives.

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[4] J. Jorgenson, personal communication, cited in National Research Council 2003.

Oil and Gas Development and Production

Gravel extraction within the planning area results in an open pit that gradually fills with water. The result is a permanent loss of the wetland type at the proposed site, which is replaced with an open water type. If the site is rehabilitated, the resulting water may eventually provide important functions common to typical Arctic lakes and ponds. The effect is nevertheless considered adverse and persists indefinitely. Gravel mining is permitted throughout the entire planning area on a case-by-case basis, with the exception of the three-mile setback along Fish Creek (**Map 2-9** in **Appendix A**). Based on the projections presented in **Appendix B**, **Table B-9**, the surface disturbance from gravel mining in the planning area under Alternative A is expected to be 89 acres, 130 acres, or 236 acres for the theoretical low, medium, or high development scenarios, respectively.

Impacts from the placement of fill material for roads, pads, airstrips, and vertical support members for pipelines are considered direct effects and will result in the permanent loss of structure and function of both wetlands and waters. Locating footprints for fill areas within the dryer wetland types (preferably Freshwater Emergent wetlands corresponding to Mesic Herbaceous, Tussock Tundra, or Mesic Sedge-Dwarf Shrub Tundra vegetation types) may decrease the severity of indirect effects associated with fill placement, such as the alteration of wetter habitats used by waterbirds and shorebirds. Based on the projections presented in **Appendix B**, **Table B-9**, the surface disturbance from gravel fill in the planning area under Alternative A is expected to be 530 acres, 782 acres, or 1,375 acres for the theoretical low, medium, or high development scenarios, respectively.

Indirect effects from fill placement include the deposition of fugitive dust from vehicle spray, changes to hydrologic patterns due to drifted snow, impounded drainages, and increased thermokarst at the edges of the fill areas. Dust deposition has been shown to impact tundra vegetation up to 328 feet from the roadways (Myers-Smith et al. 2006). The dryer wetland types within the Freshwater Emergent class that support mosses and lichens in particular are most susceptible to dust impacts, whereas the wetter classes function well in removal of pollutants. Overall, dust deposition is an adverse effect that persists in the environment indefinitely. Under the Preferred Alternative (B-2) selected in the ROD for the 2012 IAP/EIS Table 2-2, it was estimated that approximately 4,316 acres of vegetation might be subject to heavy dust deposition (“smothering”), and another 17,000 acres would be affected by lighter dust deposition (Section 4.5.5.2 in BLM 2012). No updates to the area potentially affected by dust deposition were prepared for this EIS. Drifted snow and impounded drainages may cause hydrologic changes that alter wetlands immediately adjacent to pads or roadways and portions of pipeline corridors. Hydrologic changes are most likely adverse, increasing the likelihood of permafrost thaw and potentially increasing thermokarst damage, which is very difficult to reverse.

Construction of aboveground oil pipelines results in the direct loss of wetlands due to excavation for vertical support members and placement of the resulting spoil on the adjacent tundra. Based on the projections presented in **Appendix B**, **Section B.5**, the surface disturbance from the installation of vertical support members and elevated pipelines in the planning area is expected to be 1 acre, 6 acres, or 10 acres for the theoretical low, medium, or high development scenarios, respectively; these numbers are not broken down by alternative. The 2012 IAP/EIS Section 3.4.10.4 assumed that, in contrast to oil pipelines, gas pipelines would be buried, resulting in direct loss of wetlands in the trench footprint and indirect impacts to adjacent wetlands. This disturbance would be long-term, unless rehabilitation treatments were applied (see

Abandonment and Reclamation below). Under the Preferred Alternative (B-2) selected in the ROD for the 2012 IAP/EIS Table 2-2, the total area that would be directly impacted by buried gas pipelines was estimated at approximately 1,631 acres (Section 4.5.5.2 in BLM 2012). No updates to the area potentially affected by buried gas pipelines were prepared for this EIS, so the acreage figures from the 2012 IAP/EIS are assumed to apply to all current alternatives.

The type, severity, and probability of spills occurring during project construction and production phases are evaluated in detail in **Appendix I**, **Section I.2**. Spill prevention plans that would be required by a permittee are listed in ROP A-3 and A-4. Spills are typically hydrocarbons or seawater but may be varying potentially hazardous substances and impacts can vary greatly depending on the size of the spill and whether undisturbed wetlands and waters are contacted. Spills that are contained within areas of gravel fill do not impact wetlands or waters unless contaminated gravel leaches pollutants into surrounding areas. Large spills are estimated to occur at a rate of 0.65 spills per billion barrels of oil (**Appendix I**, **Section I.2.1**). Effects of large spills on wetlands or waters, regardless of the specific wetland class affected, would be adverse and likely to persist over the long-term. Impacts to the structure and function of wetlands and waters likely would degrade most naturally occurring wetland functions. The cleanup and remediation of any spills would be conducted in accordance with the Tundra Treatment Guidelines (Cater 2010).

Abandonment and Reclamation

Activities associated with abandonment and reclamation that could have direct and indirect impacts on wetlands and waters include construction of ice roads, off-road tundra travel, removal of gravel roads and pads, removal of vertical support members and power poles, and application of rehabilitation treatments. The direct impacts of ice road construction and tundra travel would be similar to those described under Oil and Gas Exploration above. Adverse direct impacts to wetlands could occur during removal of vertical support members and power poles; these impacts would be localized to the immediate vicinity of the structures being removed. The direct impacts of gravel removal and rehabilitation treatments would likely be beneficial over the long term, resulting in more rapid vegetation recovery. By removing gravel and potentially adding treatments such as fertilizer and seed mixes, a functioning plant community may establish over the course of 10 to 15 years (Kidd et al. 2006). The results of gravel removal and treatments would improve the functioning of the developing wetlands in comparison to barren gravel but would not be expected to re-establish all of the function of the original tundra surface (Jorgenson et al. 2003, Kearns et al. 2015). The most difficult problem with disturbances caused by the placement of fill is the prevention of subsidence when gravel is removed. If subsidence cannot be stabilized, thermokarst may continue to increase and the site may never recover the original wetland functions (Kidd et al. 2006).

Community Infrastructure, Scientific, and Subsistence Activities

Impacts from activities not related to oil and gas development are summarized in the 2012 NPR-A IAP/EIS (BLM 2012). Typically smaller in scope, these activities include the use of off-road vehicles (wheeled or tracked), cleanup activities at former defense sites, overland moves between communities, scientific research camps, archeological digs, off-runway landings, new community infrastructure, and possible roads for transportation between remote communities. Though clearly of reduced magnitude, all these activities could have potential adverse direct and indirect effects on wetlands that are similar in nature to those described above for oil and gas development. Overland vehicle traffic has the potential to disturb saturated wetland types dominated by tussocks in a similar manner to seismic exploration. Cleanup activities, scientific research camps, archeological digs, and new community infrastructure would involve surface disturbance activities that could remove vegetation and alter plant communities. These impacts would range from temporary (cleanup sites) to permanent (new community infrastructure) depending on the extent and duration of the activities.

Table 3-25
Acreages Open and Closed to Fluid Mineral Leasing by Development Potential Zone Under Alternative A

Lease	Acres Open and Closed to Fluid Mineral Leasing Under Alternative A		
	High Development Potential Zone	Medium Development Potential Zone	Low Development Potential Zone
Total Open	2,065,000	5,758,000	3,938,000
Standard Terms and Conditions	1,428,000	4,595,000	3,247,000
NSO	637,000	1,163,000	691,000
Closed	1,516,000	1,926,000	7,550,000

The acreages of each wetland class that occur in each of the areas open to fluid mineral leasing and in those areas closed to leasing stratified by high, medium, and low development potential zone under Alternative A are listed in **Tables K-4 to K-14** in **Appendix K**.

Impacts Common to All Action Alternatives

The impacts discussed above under Alternative A would also occur for each of the action alternatives, for oil and gas exploration and development activities, and for community infrastructure, scientific, and subsistence activities. As discussed below in the sections for each action alternative, the primary differences between Alternative A and the action alternatives are in the areas that would be made available for leasing and the areal coverage of the various leasing stipulations for each action alternative.

Additionally, for the action alternatives, a number of specific procedures that could result in impacts or minimize impacts on wetlands and waters are the same for each action alternative; these procedures include:

- Changes to overall area (increases and reductions) not available for fluid mineral leasing (**Table K-10** in **Appendix K**)
- NSO stipulations for rivers and streams would prohibit the development of new infrastructure within specific setback distances (which vary among the action alternatives, see below); exceptions would be made for essential road and pipeline crossings; the individual approval process for proposed actions in NSO areas may provide opportunities for avoidance and minimization of high-value wetland types.
- Community infrastructure projects may be permitted (with appropriate mitigation) in areas closed to oil and gas leasing and development.
- Non-oil and gas activities include (but are not limited to) scientific use permits, sand and gravel mining, municipal development, road projects, and recreational permits.
- Permit applications for sand and gravel mining would be considered throughout the planning area (the same as under Alternative A), with the exception of a 3-mile setback along a portion Fish Creek.

Alternative B

Under Alternative B in the high development potential zone, the area not available for leasing would increase to a total of 1,727,000 (**Table K-13** in **Appendix K**) acres, which would protect wetlands and waters in their natural state. An exception to wetland conservation within the areas closed to leasing would be two potential pipeline corridors. The changes to the boundaries of the areas closed to leasing under Alternative B include higher value wetlands such as Freshwater Emergent/Freshwater Marsh (*Carex aquatilis*) (20 percent of the area) and Freshwater Emergent/Wet Sedge (25 percent). Additionally, compared with Alternative A, there is less dominance of mesic and tussock tundra types under Alternative B (**Table K-13** in **Appendix K**).

Areas closed to leasing increase dramatically within the medium and low development potential areas with 2,266,000 and 7,341,000 acres, respectively, protected from oil and gas development. Wetlands in the medium development potential area are dominated by higher value Freshwater Emergent/Fresh Water Marsh (*Carex aquatilis*) wetlands (22 percent of the total area; **Table K-14**, **Appendix K**). Wetlands in the low development potential area are dominated by dryer, lower value Freshwater Emergent/Tussock Shrub Tundra (44 percent of the total area; **Table K-15**, **Appendix K**).

Under Alternative B, the NSO stipulations specify a setback of 7 miles for the Colville River and variable setback distances for other specific streams, which would protect wetlands and waters in those buffer zones and apply to high, medium, and low development potential areas (**Map 2-2** in **Appendix A**). As under Alternative A, exceptions can be made for the construction of essential road and pipeline crossings within stream setbacks. NSO stipulations for deepwater lakes (**K-2**, **Table 2-3** in **Chapter 2**) under Alternative B prohibit the construction of any new infrastructure in buffer zones around those waterbodies, which would protect wetland marshes along the margins of lakes (that provide high-value habitat for waterbirds) as well as help protect adjacent wetlands (**Appendix A**, **Map 2-2**).

The remaining area open to fluid mineral leasing falls in the standard terms and conditions management category, subject to a variety of ROPs and stipulations that minimize the extent of the footprint, avoid sensitive wildlife habitat, or reduce wetlands degradation but do not prevent wetland loss to oil and gas development. In total, the area open to fluid mineral leasing in the high, medium, and low development potential areas combined decreases from a total of 7,916,000 acres under Alternative A to 6,676,000 acres under Alternative B (**Table K-5** through **K-7** in **Appendix K**). The area open for leasing is primarily located in inland areas south of the Teshekpuk Lake Special Area, and the wetland types in that area are dominated by Freshwater Emergent/Tussock Tundra and Freshwater Emergent/Tussock Shrub Tundra. Areas subject to timing limitations overlap with other management categories and are not considered to have a beneficial or detrimental effect on wetlands or waters.

Table 3-26
Acreages Open and Closed to Fluid Mineral Leasing by Development Potential Zone Under Alternative B

Lease	Acres Open and Closed to Fluid Mineral Leasing Under Alternative B		
	High Development Potential Zone	Medium Development Potential Zone	Low Development Potential Zone
Total Open	1,856,000	5,419,000	4,147,000
Standard Terms and Conditions	1,094,000	3,794,000	2,743,000
NSO	762,000	1,625,000	1,404,000
Closed	1,725,000	2,266,000	7,341,000

Non-oil and gas impacts are regulated through both NSO and standard terms and conditions management criteria under Alternative B. As noted in the *Community Infrastructure, Scientific, and Subsistence Activities* section above, the impacts are expected to be similar to those discussed under *Impacts Common to All Action Alternatives* but at a smaller scale.

Based on the projections presented in **Appendix B**, **Table B-9**, the surface disturbance from gravel mining in the planning area under Alternative B is expected to be 80 acres, 117 acres, or 212 acres for the theoretical low, medium, or high development scenarios, respectively. Similarly, the surface disturbance from gravel fill in the planning area under Alternative B is expected to be 476 acres, 703 acres, or 1,236 acres for the theoretical low, medium, or high development scenarios, respectively.

Alternative C

Within the high development potential zone under Alternative C, lease stipulations and ROPs would be adjusted to allow leasing and new infrastructure within the Teshekpuk Lake Special Area boundaries, but a core area that is closed to leasing and new infrastructure would be retained. Areas open for lease under Alternative C that provide limited protection for wetlands include those subject to standard terms and conditions and those subject to NSO, which combined account for 16,430,000 acres in high, medium, and low development potential zones (**Tables K-5** through **K-9** in **Appendix K**). Relative to Alternative A, Alternative C represents a 37 percent increase in lands available for lease and thus potentially subject to permanent loss of wetlands or waters of the U.S.

Under Alternative C, the NSO stipulations would specify a setback of 3 miles for the Colville River and variable setback distances for other specific streams, which would protect vegetation in those buffer zones. As under Alternative A, exceptions can be made for the construction of essential road and pipeline crossings within stream setbacks. NSO stipulations for the buffer zones around deepwater lakes under Alternative C allow for the construction of new infrastructure, but under ROP restrictions. On a case-by-case basis, these stipulations would help protect wetland marshes along the margins of lakes (which provide high-value habitat for waterbirds) as well as help protect adjacent wetlands.

Of the areas open to leasing under Alternative C, the protected areas with NSO conditions, but without the caveat for the construction of essential roads and pipelines, are limited to the areas surrounding Teshekpuk Lake and the Pik Dunes. The areas subject to standard terms and conditions provide a variety of ROPs that minimize the impact footprint, preserve known wildlife wetland habitats, and reduce degradation during the construction and production phases (**Chapter 2**, **Table 2-3**). Areas subject to timing limitations overlap with other management categories and are not considered to have a beneficial or detrimental effect on wetlands or waters.

Non-oil and gas impacts are regulated through both NSO and standard terms and conditions management criteria under Alternative C. As noted in the *Community Infrastructure, Scientific, and Subsistence Activities* section above, the impacts are expected to be similar to those discussed under *Impacts Common to All Action Alternatives* but at a smaller scale.

Based on the projections presented in **Appendix B**, **Table B-9**, the surface disturbance from gravel mining in the planning area under Alternative C is expected to be 112 acres, 164 acres, or 297 acres for the theoretical low, medium, or high development scenarios, respectively. Similarly, the surface disturbance from gravel fill in the planning area under Alternative C is expected to be 669 acres, 987 acres, or 1,736 acres for the theoretical low, medium, or high development scenarios, respectively (**Section 8**, **Appendix B**).

Table 3-27
Acreages Open and Closed to Fluid Mineral Leasing by Development Potential Zone Under Alternative C

Lease	Acres Open and Closed to Fluid Mineral Leasing Under Alternative C		
	High Development Potential Zone	Medium Development Potential Zone	Low Development Potential Zone
Total Open	2,606,000	7,384,000	7,062,000
Standard Terms and Conditions	1,394,000	4,352,000	5,678,000
NSO	1,015,000	2,603,000	1,384,000
Timing Limitation	197,000	429,000	0
Closed	974,000	300,000	4,427,000

Alternative D

Within the high development potential zone under Alternative D, the Teshekpuk Special Area would be open to fluid mineral leasing, and no acres are closed to fluid mineral leasing. As under Alternative A, the areas subject to standard terms and conditions and NSO stipulations under Alternative D in the high development potential zone are dominated by Freshwater Emergent/Tussock Tundra and Freshwater Emergent/Tussock Shrub Tundra, which account for 27 percent and 50 percent, respectively, of the acreage in the high development potential zone. The controlled surface use area is dominated by Freshwater Emergent/Fresh Water Marsh (*Carex aquatilis*) and Freshwater Emergent/Wet Sedge, which account for 52 percent and 49 percent, respectively, of the acreage in the high development potential zone. The controlled surface use area is concentrated in the areas immediately surrounding Teshekpuk Lake, which are dominated by extensive wetland complexes.

NSO stipulations under Alternative D for specific rivers and streams and for deepwater lakes are the same as those under Alternative C. Stipulations for controlled surface use allow for some surface occupancy and use for development, but constraints on operations would be enacted for sensitive or special resources, particularly sensitive waterfowl habitat (**Table K-3**, **Appendix K**). Under Alternative D, the controlled surface use sensitive resources stipulations for goose molting areas (K-6 Goose Molting Area) and brant nesting colonies (K-8 Brant Survey Area) would allow for new infrastructure but only under specific ROPs. On a case-by-case basis, these controlled surface use stipulations would help protect wetland resources in areas used by molting geese and nesting brant. Of the areas open to leasing under Alternative D, the protected areas with NSO conditions, but without the caveat for the construction of essential roads and pipelines, are limited to the areas immediately surrounding Teshekpuk Lake and the Pik Dunes. Areas subject to timing limitations overlap with other management categories and are not considered to have a beneficial or detrimental effect on wetlands or waters.

Non-oil and gas impacts are regulated through both NSO and standard terms and conditions management criteria under Alternative D. As noted in the *Community Infrastructure, Scientific, and Subsistence Activities* section above, the impacts are expected to be similar to those discussed under *Impacts Common to All Action Alternatives* but at a smaller scale. Under Alternative D, the majority of lands closed to oil and gas leasing are within the low development potential zone but would still be open to non-oil and gas activities under standard terms and conditions and NSO stipulations.

Table 3-28
Acreages Open and Closed to Fluid Mineral Leasing by Development Potential Zone Under Alternative D

Lease	Acres Open and Closed to Fluid Mineral Leasing Under Alternative D		
	High Development Potential Zone	Medium Development Potential Zone	Low Development Potential Zone
Total Open	3,581,000	7,680,000	7,062,000
Standard Terms and Conditions	1,402,000	4,722,000	5,946,000
NSO	1,429,000	2,108,000	1,116,000
Controlled surface use	187,000	251,000	0
Timing limitations	563,000	599,000	0
Closed	0	3,000	4,427,000

Based on the projections presented in **Appendix B**, **Table B-9**, the surface disturbance from gravel mining in the planning area under Alternative D is expected to be 154 acres, 225 acres, or 409 acres for the theoretical low, medium, or high development scenarios, respectively. Similarly, the surface disturbance from gravel fill in the planning area under Alternative D is expected to be 919 acres, 1,356 acres, or 2,385 acres for the theoretical low, medium, or high development scenarios, respectively.

Cumulative Impacts

The geographic area considered for cumulative impacts includes the entire Arctic Coastal Plain and the foothills of the Brooks Range, and the time frame for the analysis includes all past and present (existing) developments on the coastal plain (approximately 1970) and then extends forward 70 years after the signing of the ROD for this IAP. The Arctic Coastal Plain was selected as the geographic area for cumulative effects because it is predicted to be a refugia biome resisting biome change due to climate change through the year 2099 (Murhpy et al. 2010). The future 70-year time frame follows from **Appendix F**, **Section F.2.1.** in which it is noted that individual petroleum projects can be actively producing for 10–70 years. Past and present projects within the planning area, and thus managed under the existing 2012 IAP/EIS (BLM 2012), were discussed briefly in the *Affected Environment* section above.

Cumulative effects to wetlands from development and land-use activities in the past, present, and reasonably foreseeable future include construction and maintenance of ROWs, transportation, infrastructure, continued and new mining and oil and gas operations, recreational uses, subsistence uses, military projects, as well as natural events (such as wildfire, flooding, and changes in climate). The upcoming GMT2 and Willow projects, Alaska pipeline projects, and seismic exploration projects would have impacts as described for oil and gas developments above. When combined with the alternatives discussed in this EIS, these actions or events occurring in the planning area could affect wetlands in ways similar to the impacts described above and in Section 4.6.3 of the 2012 IAP/EIS (BLM 2012). The effects of climate change described under *Affected Environment*, above, could influence the rate or degree of the potential cumulative impacts.

In more remote areas, natural events (e.g., floods, wildfires, permafrost degradation, avalanches, freeze/thaw dynamics, insect and disease outbreaks, alterations in wildlife behavior, and changes in climate) would have the greatest effects on wetlands, while areas near existing or future developments would be at a greater risk for anthropogenic impacts (e.g., infrastructure development, spread of NNIS, fluid and mineral mining, and recreation). The contribution to cumulative impacts from these types of anthropogenic actions would be reduced through future environmental compliance requirements (NEPA, Clean Water Act, ESA) at the local leasing or project design levels. However, due to the sensitivity of wetlands and plant communities and the low overall human-disturbance levels in the planning area, most projects are likely to contribute to adverse cumulative effects on wetlands and waters.

Cumulative impacts would potentially occur under all proposed action alternatives. Alternative D would result in the greatest contribution to cumulative impacts and Alternative B the least, based on land areas available for leasing, specific leasing stipulations, RFD scenarios, and the protections provided in the Teshekpuk Lake Special Area, which vary among the action alternatives.

In addition to those projects under current operations on the Arctic Coastal Plain, the upcoming GMT2 and Willow projects represent similar oil and gas developments in the reasonably foreseeable future that are within the management boundaries of the planning area. Beyond the boundaries of the planning area, Point Thomson, the Greater Prudhoe Bay/Deadhorse Area, and the Kuparuk River field are all operational and are likely to continue to contribute additive direct and indirect effects of oil and gas development, as described in the *Impacts Common to All Action Alternatives* section above. RFFAs in the cumulative impacts analysis area include the Nanushuk field, Alaska LNG pipeline, ASAP, and the SAE 3D seismic survey in the ANWR. In addition to the larger oil and gas projects, there are existing and reasonably foreseeable community infrastructure projects, scientific research camps, and subsistence impacts, as described in the *Impacts Common to All Action Alternatives* section above.

Comprehensive mapping data are not available for all the RFFAs to facilitate a meaningful quantitative analysis of the cumulative loss of wetland habitats; however, all listed developments will contribute additive impacts to existing and proposed developments within the planning area. While most direct effects constitute a permanent loss of wetlands or waters of the U.S., which are ubiquitous on the coastal plain and not likely to be globally imperiled, the most concerning cumulative effects may be the loss of specific high-value wetlands, such as those in the Teshekpuk Lake area (high-value for wildlife) or the Pik Dunes (high-value for plant communities with rare species). Regardless of what high-value wetland areas are identified and protected, climate change will also contribute to cumulative impacts, in the form of altered wetland habitats across the entire coastal plain, as described in the *Affected Environment* section above.

Of the action alternatives, Alternative B would provide the most protection for existing high-value wetland areas within the high development potential zone, with the total area protected in the Teshekpuk Lake Special Area totaling 1,721,000 acres. Alternative D would provide the least protection, with all of the Teshekpuk Lake Special Area opened to oil and gas leasing.

3.3.3 Fish

Affected Environment

The description of the affected environment for fish in this section represents a modified, condensed text based on the 2012 IAP/EIS (BLM 2012). For more detailed information on the affected environment, see Section 3.3.4 of the 2012 IAP/EIS. The habitat descriptions herein follow the same general outline of that document. Several field studies have been conducted since that report was published. We have cited the pertinent literature from those efforts, which may improve our understanding of the affected environment for fish and aquatic species in the NPR-A.

Fish Habitat

The quality of fish habitat in the NPR-A is influenced by the location, abundance, size, morphology, and in some cases the degree of connectivity of the rivers, streams, lakes, and nearshore habitat (Arp et al. 2015; Heim et al. 2015, 2016, and 2019; Jones et al. 2013; Laske et al 2016; McFarland et al. 2017). The natural balance of physical and chemical attributes of these waterbodies, in turn, control the diversity and distribution of fish. Rivers in the NPR-A flow through three physiographic regions designated as the Arctic Mountains, Arctic Foothills, and Arctic Coastal Plain provinces (Warhaftig 1965; **Appendix A**, **Map 3-1**). The vast majority of rivers and streams flow through the flat Arctic Coastal Plain, which is associated with poorly developed drainage networks. Conversely, relatively few riverine habitats are associated with upland, gravel-dominated substrate. Roughly three-quarters of the NPR-A drains into the western Beaufort Sea, with the remaining area draining into the northeast Chukchi Sea (**Appendix A**, **Map 3-1**). The vast majority of these habitats currently exhibit few if any impacts from anthropogenic activities.

Lakes are a dominant feature in the NPR-A, particularly on the coastal plain, with thousands ranging from shallow ponds to deep expansive waterbodies (Jones et al. 2017) (**Appendix A**, **Map 3-7**). Lake connectivity to flowing waters and other, adjacent waterbodies determines fish use, which is highly influenced by annual flow regimes in streams and rivers (Laske et al. 2016). Lake connections vary greatly, with some accessible throughout the open-water season and others only connected during high flows in the spring (Jones et al. 2017). Lakes which are flooded annually or semi-annually can be occupied by almost any species found in adjacent rivers, while infrequently flooded lakes typically have less diverse fish communities or are fishless (Moulton 1998, 2001a, 2003a). Moulton (1998) developed an Arctic-based classification system for lake types based on fish access potential, which defines four lake types:

- Drainage: active year-round connection to a river or stream and do not drain
- Tapped: active connection to a river or stream during the summer and intermittent connection as water levels recede
- Perched: lack well-defined connections to river or stream channels and flood under high water conditions, but do not drain like tapped lakes when floodwaters recede.
- Tundra: not connected to, nor regularly flooded by rivers and are typically thaw-lakes.

Fish species located in NPR-A lakes are uniquely adapted to survive the extreme climatic conditions of the region (Haynes et al. 2014). Necessary habitat features common to all fish species in the NPR-A include suitable conditions for feeding, spawning, overwintering, and for some species, seasonal migrations. The 3- to 4-month Arctic summer is the critical time for fish to find quality feeding habitat (Craig 1989a), and it is during this period that Arctic fish achieve most of their yearly growth (Fechhelm et al. 1992; Griffiths et al. 1992) as well as accumulate fat and protein reserves needed to overwinter (Fechhelm et al. 1995, 1996). The NPR-A is rich with exploitable food resources for fish, including aquatic invertebrates and their larvae, zooplankton, smaller fish, and fish eggs (Bendock and Burr 1984; Craig 1984a, 1989a; Moulton et al. 2007, 2010; Bond and Erickson 1985; Laske et al. 2018). Small tributaries are more productive than main river channels and may be more highly utilized as feeding habitat (Morris 2003; Moulton 2005; Moulton et al. 2007), though temperatures above species' tolerance levels in June and July may lead fish to seek more suitable feeding areas in deeper channel habitat or lakes (Moulton 2005). Estuarine zones near river mouths, with a mix of freshwater and marine invertebrates, are particularly productive feeding habitats (Craig 1984a) and many fish move from freshwater habitats to this estuarine zone to take advantage of the increased food supply.

Spawning habitat requirements for Arctic fish species vary greatly with respect to both substrate (e.g., gravel, silt, sand) and flow regime (flowing or still water). However, it is important to note that gravel is relatively uncommon in much of the NPR-A; many of the areas having gravel substrate are in the upper reaches of rivers in foothills topography and freeze completely in winter, limiting the ability for gravel-dependent fertilized eggs to survive the winter. Aside from burbot, which spawn under ice in late winter, most freshwater fish of the NPR-A spawn between breakup (late May or June) and late fall (October).

Overwintering habitat is a major constraint on fish populations in the Arctic (Schmidt et al. 1989, Gallaway 1990). During winter ice formation, stream habitat is reduced by up to 95 percent, causing fish to migrate to limited deepwater sites in lakes, rivers, and coastal areas to overwinter. Because typical ice thickness reaches 2 meters depth during winter, water depths of approximately 7 feet are necessary to supporting overwintering freshwater fish (Michael Baker Jr. Inc. 2002; Hinzman et al. 2006; Hilton et al. 2009). These overwintering waters must also be of sufficient volume to sustain fish oxygen demands for several months (Cott et al. 2008; Leppi et al. 2015).

Migration corridors are required for many Arctic fish because feeding, spawning, and overwintering habitat are not typically contained in a single location for a given fish, thereby necessitating seasonal or annual movements. Fish may migrate locally or extensively to reach suitable habitat (Morris 2000; Morris 2003; Bond and Erickson 1985; Strange 1985). These migrations are affected by waterbody connectivity and flow regimes (MJM Research 2005, 2007; Heim 2015).

Fish Habitat Units

Due to differences in topography and other physical environmental factors throughout the vast NPR-A, six habitat units were delineated based on features unique to those large geographic areas during production of the 2012 IAP/EIS (BLM 2012, Section 3.3.4.2) (**Appendix L, L.1–L.6**). These habitat units were modified from a previous BLM 105(c) land-use study (USDOI BLM 1978a) based on USGS hydrologic units (**Appendix A, Map 3-1**) and physiographic regions established by Warhaftig (1965). The units include the Lower Colville, Mountain Headwaters, Coastal Plain, Foothills, Utukok/Kokolik, and Coastal Marine (**Appendix L, L.1–L.6** and **Map L-1**). The extent of streams and lakes providing potential fish habitat in the NPR-A fish habitat units is included in (**Table L-1** in **Appendix L**), calculated from the USGS National Hydrography Dataset. While not all streams and lakes are fish-bearing, this analysis provides a representative index of aquatic habitat in the NPR-A, a majority of which is utilized by fish. For a detailed description of how linear stream segments and lake polygons were classified and utilized for this analysis, refer to Section 3.3.4.2 in BLM (2012).

Fish Species

Information on fish species occurrence in the planning area and the scientific literature documentation for the presence of fish species in the area is summarized in Section 3.3.4.3 in BLM (2012) and is not repeated here.

Freshwater Fish

Freshwater fish species largely remain within river, stream, and lake systems year-round. While a small number of individuals may venture into coastal areas where waters are brackish during summer (e.g., Round Whitefish), species discussed here predominantly remain in inland waters. Arctic Grayling is the most widespread freshwater fish species in the NPR-A, distributed throughout all of the major river drainages, including many small tributaries and lakes. Other freshwater fish species in the NPR-A include Lake Trout, Burbot, Northern Pike, Arctic Char, Longnose Sucker, Ninespine Stickleback, Slimy Sculpin, and Alaska Blackfish (**Appendix L, Table L-2**).

Anadromous Fish

Due to the vast size and remote nature of the planning area, fish resources are not well-documented for the majority of waterbodies in the NPR-A. Waterbodies currently recognized for various anadromous fish species as part of the Anadromous Waters Catalog are shown on **Map 3-9** in **Appendix A**. Though a useful tool in predicting the likelihood of anadromous fish presence in any given waterbody, the Anadromous Waters Catalog should be considered incomplete for waters in the planning area. Anadromous fish species breed in freshwater but spend at least part of their life cycle in the marine or brackish waters (Craig 1989a). Because all the species noted below have at least some anadromous populations, occurrence in the Anadromous Waters Catalog is implicit; some species are also more prevalent than others in a given fish habitat unit. Anadromous species found in the NPR-A include Broad Whitefish, Humpback Whitefish, Arctic Cisco, and Bering Cisco. Least Cisco can utilize a wide range of habitats, some are anadromous while others reside only in freshwater. In the northeastern Chukchi Sea and western Beaufort Sea, all five species of Pacific salmon (pink, chum, chinook, coho, and sockeye salmon) have been reported. Pink and chum salmon occur in the greatest numbers, although their abundance is low compared to other fish species in the region. Chinook salmon are much more uncommon in the NPR-A; sockeye and coho salmon are rare. Freshwater captures are often limited to only one or a few individuals. The capture of any juvenile salmon in the Arctic is extremely rare, although chum salmon smolts have been captured in the Colville River Delta. Rainbow Smelt, Threespine Stickleback, and Arctic Lamprey are also present in the NPR-A. A detailed list of anadromous fish species in the NPR-A may be found in Section 3.3.4.3 in BLM (2012).

Coastal Marine Fish

Fish classified as marine typically spend their entire lives at sea, though there are many examples of some of these species migrating into nearshore, brackish waters during summer and some may travel considerable distances upriver depending on upstream salt-wedge movement (e.g., Fourhorn Sculpin in the Colville River). During winter, most of these species move offshore to warmer marine areas or utilize suitable estuarine habitat. Over 60 fish species (anadromous and marine) are known to utilize coastal waters along the western Beaufort Sea (Craig 1984a), with a greater number in coastal waters of the northeast Chukchi Sea (Morris 1981, Craig and Skvorc 1982). Six species comprise the majority of marine fish captured in the coastal NPR-A: Fourhorn Sculpin, Arctic Flounder, Saffron Cod, Pacific Herring, Capelin, and Arctic Cod. Additional information on the life history attributes for fish species in the program area can be found in Section 3.3.4.3 in BLM (2012).

Commercial Fishing

At this time, the North Pacific Fishery Management Council's (2009) "Fishery Management Plan for Fish Resources of the Arctic Management Area" has established policy to prohibit commercial fishing in the Arctic until enough information exists to develop a sustainable commercial fishery. The Arctic Management Area includes the portions of the Chukchi and Beaufort seas within the U.S. Exclusive Economic Zone (from 3 nautical miles offshore to 200 nautical miles offshore).

Essential Fish Habitat

The 1996 Sustainable Fisheries Act enacted additional management measures to protect commercially harvested fish species from overfishing. Along with reauthorizing the Magnuson-Stevens Fishery Conservation and Management Act Reauthorization (16 U.S.C. 1801-1882), one of those added measures is to describe, identify, and minimize adverse effects to essential fish habitat. Pacific salmon essential fish habitat consists of some freshwater habitat within the NPR-A, as well as the estuarine habitat along its coast. Portions of Arctic Cod and Saffron Cod essential fish habitat includes marine waters in proximity to the NPR-A coastline (**Appendix M**, **Map M-1**) (Sigler et al 2012, Simpson et al 2017). A complete description of Arctic essential fish habitat and relevant background is included in the essential fish habitat Assessment (in **Appendix M**, **Section M.2**). However, it should be noted that essential fish habitat designations depend on several factors including a complete knowledge of area fish stocks and the likelihood that these stocks are self-sustaining. For example, the degree to which an area is designated essential fish habitat for any Pacific salmon depends on whether the area has been well-surveyed for salmon and whether any discovered salmon are likely to be from self-sustaining populations versus strays.

Climate Change

The geographic area considered for cumulative impacts for fish resources includes the entire Arctic coastal plain, adjacent nearshore waters in the Beaufort and Chukchi seas, and the foothills of the Brooks Range. As discussed in BLM (2018a), climate change is affecting many variables that then affect aquatic species and habitats, such as precipitation, timing of ice formation, permafrost degradation, changes to hydrologic functions and water quality, and temperature and DO. Increasing temperature is expected to change climate patterns and lengthen the ice-free season, degrade permafrost, and increase evaporation (SNAP 2018); these processes contribute to surface water hydrology and may reduce (Laske et al. 2016) or increase (Stuefer et al. 2017) surface water connectivity among waterbodies. For example, reductions in connectivity from drying of channels or ponds may in turn reduce colonization opportunities for fish by limiting dispersal pathways and movement between habitats (Laske et al. 2016). This could change local species assemblages or species richness.

Warmer water temperatures may also increase biological productivity (Beaver et al. 2019) and fish growth (Mallet et al. 1999, Railsback and Rose 1999). However, for each fish species there exists an upper limit of temperature tolerance before stress and mortality begin to appear from excessive energetic demands (Magnuson et al. 1979, Tonn 1990). Additionally, warmer water temperatures may increase susceptibility to diseases and parasites (Roberts 1975), increase the effects of contaminants (Schiedek et al. 2007), and decrease biologically available DO (Ficke et al. 2007). Warming may also lead to changes in overwintering habitat due to a later freeze-up date and an earlier thaw date, reducing the under-ice overwintering period for fish (SNAP 2018).

Direct and Indirect Impacts

Impacts Analysis Assumptions

- Not all streams and lakes in the planning area are fish-bearing, and essential fish habitat and Anadromous Waters Catalog designations for the NPR-A are incomplete. Therefore, this analysis relies on a representative index (i.e., Anadromous Waters Catalog) of aquatic resources in the NPR-A. The analysis assumes that a majority of the planning area is utilized by fish.
- The high development potential zone (see **Appendix B**, **Map B-1)** predominately encompasses lands in the Lower Colville River and coastal plain fish habitat units (**Appendix A**, **Map 3-1**); therefore, the impact analysis primarily focuses on impacts on these units, which have the greatest likelihood of being impacted by development activities under all alternatives. Impacts on other units would be of the same type but would be less likely to occur.
- Deep (1.6–4 m) and very deep (greater than 4 m) lake habitats are collectively referred to as "deep" lake habitat. For the purposes of this analysis, it is assumed that both depth ranges provide fish habitat.

Impacts Common to All Alternatives

Activities associated with oil and gas

Oil and gas leasing and exploration activities that could affect fish and fish habitat would occur under all action alternatives, though their locations relative to fish habitat units could vary.

Potential effects on aquatic species and habitats from other phases, including exploration, development, production, and abandonment/reclamation are summarized below. Areas currently designated as having a high likelihood of oil and gas development (**Appendix B**, **Map B-1**) (i.e., much of the Lower Colville and coastal plain fish habitat units; Fish Habitat Units, **Appendix L**, **Map L-1**) correspond to some of the areas for which fish assemblages are best understood in the NPR-A, as indicated in the Anadromous Waters Catalog (Johnson and Blossom 2019).

Under all alternatives, all major rivers and streams in the NPR-A have 0.5- to 7-mile setback buffers, which would help limit direct disturbance to fish and alteration of habitat. However, within these buffers, permittees could construct essential pipelines and roads that cross the river or stream, but no other permanent infrastructure would be permitted. The Peard Bay and Kasegaluk Lagoon Special Areas and Wainwright Inlet/Kuk River would remain closed to leasing under all alternatives, but sand and gravel mining would be authorized on a case-by-case basis throughout the planning area, with the exception of a 3-mile buffer along Fish Creek. Specific lease stipulations and ROPs apply to fish protections throughout the entire planning area (see **Table 2-2** in **Chapter 2**).

The effects of climate change described in the *Affected Environment* section above, could influence the rate or degree of the potential direct and indirect impacts.

Direct Habitat Loss or Alteration

Activities with the potential to affect fish and aquatic species would stem largely from oil and gas development projects and include the construction and operation of new gravel roads, gravel pads, airstrips, pipelines, culverts, bridges and barge landings or docks, and gravel mining. Infrastructure would mainly follow from the development phase of the post-leasing activities. Permanent loss or alteration of aquatic habitats would occur due to the placement of fill associated with infrastructure. BMP (Alternative A) and ROP (Alternatives B–D) and lease stipulations would govern the ultimate placement of gravel fill, but fill placed near waterbodies could alter aquatic habitats and directly or indirectly (as described below in Indirect Habitat Alteration) affect fish. If gravel mining occurs adjacent to waterbodies or floodplains, these impacts would be reduced as compared to those constructed directly in waterbodies. A typical satellite well pad associated with potential future development in NPR-A would lead to approximately 15 acres of ground disturbance and roads would cause ground disturbance of approximately 7.5 acres per mile. See the sections below, organized by alternative, for information on the surface area that could theoretically be affected by gravel fill under each alternative.

Existing habitats in potential gravel mining sites would be adversely affected in the long term by the removal of substrate and the capacity of the existing habitats in the mining footprint to contribute nutrients or organic matter to the waterbody. Water quality also would be degraded in the short term due to increased turbidity, which could lead to changes in DO or other water quality changes (see **Section 3.2.11**, Water Resources). Following gravel extraction within or adjacent to waterbodies, the excavation can then serve as a water reservoir for industrial activities, which is common practice in other North Slope gravel mines farther west (BLM 2012). Gravel resources are generally scarce in the planning area, and transport of gravel from outside the planning area may be required to facilitate development (**Appendix B**, **Section B.6**). Therefore, the above impacts could have a lower likelihood of occurring in the planning area. The most likely areas of gravel mining would be in existing or new mines within the Lower Colville River and Coastal Plain fish habitat units near areas of high probability of oil and gas development. See the sections below, organized by alternative, for information on the surface area that could theoretically be affected by gravel mining under each alternative.

The RFD scenario (**Appendix B**, **Section B.5**) predicts that a barge landing and storage pad could be required to transport large equipment such as central processing facility modules and drill rigs into the development area. Marine barge landings and docks could remove marine habitat and alter rearing or nearshore foraging habitat. Potential direct aquatic habitat loss would occur in the fill footprint. During construction of docking sites, short-term water quality changes (e.g., increased turbidity) could alter habitat for fish and aquatic species and cause disturbance and displacement of fish. Development of barge landing(s) would occur in the Coastal Marine fish habitat unit, adjacent to the Coastal Plain fish habitat unit. The most likely barge ports are Utqiaġvik, Smith Bay, or Atigaruk Point (**Appendix B**, **Map B-2**).

Pipelines would be used to transport oil, water, fuel, and electricity under all alternatives and would contribute to surface disturbance (**Appendix B**, **Section B.5**). Buried pipelines, such as those associated with seawater treatment plant pipe, would alter marine sediments in the fill footprint due to trenching to bury the pipe. This would adversely affect the habitat in the short term by removing invertebrate food sources and potential algal cover in the trench footprint until the invertebrate and algal resources recover. Sedimentation and turbidity would be increased resulting in a short-term decrease in habitat suitability for some species.

Use of bridges and culverts could directly alter aquatic habitats by replacing substrates, banks, or both with metal pipe or pilings and abutments. This infrastructure would directly impact flows and therefore fish habitat or fish movement in those areas. Bridge and culvert installation would adversely affect the habitat in the long term by removing the capacity of the fill footprint to contribute nutrients or organic matter to the waterbody and by altering hydrology in the immediate area.

Indirect Habitat Alteration: Dust and Gravel Spray

Activities associated with oil and gas activities that could cause potential dust and gravel spray effects include construction and operation of new gravel roads and gravel pads and vehicle traffic on gravel infrastructure. These activities and the impacts described below would mainly occur during the development and production phases of the post-leasing program; impacts from road use would last until the road is removed or decommissioned.

Dust and gravel spray would be generated during future gravel placement, gravel compaction, and vehicle traffic on gravel roads and pads. The RFD scenario (**Appendix B**, **Section B.6**) predicts that future developments are expected to be connected by gravel roads in most cases, and therefore, dust generation from road construction and road use is likely to occur. As noted above, the most likely location of these impacts would be the Lower Colville River and Coastal Plain fish habitat units. See the sections below, organized by alternative, for information on the surface area that could theoretically be affected by gravel fill under each alternative.

Road dust accumulation is greatest within 35 feet of roads, but deposition typically occurs over a broader area. Roughly 95 percent of dust settles within 328 feet from the road surface (Myers-Smith et al. 2006; Walker and Everett 1987). Dust could increase turbidity in waterbodies next to roads and construction areas, which may inhibit normal physiological function in fish (e.g., oxygen uptake across gill membranes), and could increase sediment and gravel inputs to existing substrates. This would also have a long-term adverse effect on aquatic habitats and species by decreasing habitat quality, including through mobilization of possible contaminants specific to the underlying geology of gravel pits where sediment is mined. These sequestered chemicals or elements are not necessarily harmful themselves but could be harmful in combination with other water chemistry attributes such as pH. Dust abatement activities will require the use of additional water resources.

Indirect Habitat Alteration: Flow Alteration and Fish Passage

Oil and gas activities that could affect flow alteration and fish passage include construction of ice roads, snow management activities, use of rolligons or other off-road vehicles for seismic surveys, maintenance, and the placement of bridge piers or piles in waterbodies. Although all major rivers and streams in the NPR-A would have 0.5- to 7-mile buffers under all alternatives, permittees could construct essential pipeline and roads that cross rivers and streams within these buffers. These activities and the impacts described below could occur during all phases of the post-leasing program, and in the case of new infrastructure, would last until abandonment and removal.

Flow alteration can result from obstructions in the natural flow path, either by infrastructure or by compacted ice. Compacted ice over and surrounding waterbodies can delay ice melt and temporarily alter aquatic habitats. Compacted ice can change natural drainage patterns or cause water impoundments during spring break up. Delayed melt of ice roads or pads can also temporarily block fish passage, which can impede Arctic fish attempting to migrate from overwintering areas to feeding habitat during the early part of the open-water season (Arp et al. 2019).

As discussed in BLM (2012), many fish move upstream during breakup to access productive feeding habitat or to reach locations only accessible during spring flooding. Energy reserves in spring are typically low for most fish and additional stress or delayed access to feeding habitats could have adverse impacts (Heim et al. 2014). A barrier to passage could result in migration movements to lower quality feeding habitat and increase energetic demands, which could compromise survival. Ice compaction would temporary alter aquatic habitats near ice infrastructure or near where off-road activities would occur. This could have longer-term adverse effects on fish if their migration is annually delayed.

Culverts could be used under all action alternatives in the future for access-road water crossings and to provide cross drainage. Bridges would be required at most larger stream crossings E-14/ROP E-6. Bridge piers or piles could also alter flow due to ice blockage during spring break up. Effects would be the same as those described above for flow alteration due to ice compaction.

Objectives under E-14/ROP E-6 would be to ensure the passage of fish at stream crossings. Lessees would be required to adhere to the BMPs outlined in "Stream Crossing Design Procedure for Fish Streams on the North Slope Coastal Plain" by G.N. McDonald & Associates (1994), "Fundamentals of Culvert Design for Passage of Weak-Swimming Fish" by Behlke et al. (1991), and other generally accepted BMPs. These stipulations would reduce effects the chance of stream crossings posing barriers to fish passage.

Indirect Habitat Alteration: Water Quantity

Oil and gas activities that could affect water quantity include water withdrawal from lakes or streams for ice roads, water supply, dust suppression, maintaining reservoir pressure, and other uses. Withdrawals would occur during the exploration, development, and production phases of the post-leasing program. A typical 6-acre ice pad for exploration drilling requires 1.5 million gallons of water, while drilling and completing each production well would require anywhere from 420,000 to 8 million gallons (**Appendix B**, **Section B.7**), indicating substantial water usage would likely occur. An approved permit would be required for withdrawals. These activities are most likely to occur near areas of high oil and gas development potential, with the highest likelihood being the Lower Colville River and Coastal Plain habitat units.

Water withdrawal from lakes can affect the amount of habitat available to overwintering fish, summer habitat accessibility, and habitat characteristics. Removal or compaction of snow can also increase the depth of freezing on lakes. As a result, the water quantity available in a lake during the winter can be greatly reduced.

Unfrozen freshwater in lakes during the winter months is generally widely available in portions of the planning area that have the highest potential for leasing. Therefore, any future withdrawal from these lakes for infrastructure development/maintenance would have fewer adverse effects on fish than in other areas of the NPR-A with fewer unfrozen water resources available. Under all alternatives, withdrawal of unfrozen water from rivers and streams during winter is prohibited. The removal of ice aggregate from grounded areas ≤4-feet deep may be authorized from rivers on a site-specific basis (B-1/ROP B-1).

B-1/ROP B-1 objectives are for water withdrawals to be conducted in such a manner as to maintain populations of, and adequate habitat for, fish and invertebrates, and B-2/ROP B-2 objectives are to maintain natural hydrologic regimes in soils surrounding lakes and ponds, and maintain populations of, and adequate habitat for, fish and aquatic invertebrates. While, these stipulations would help reduce habitat loss for fish to some extent, up to 15 percent of calculated volume of water deeper than 7 feet in lakes with sensitive fish (i.e., any fish except ninespine stickleback or Alaska blackfish) and up to 30 percent of calculated volume of water deeper than 5 feet in lakes with only non-sensitive fish (i.e., ninespine stickleback or Alaska blackfish) would be permitted. If maximum withdrawal limits were reached, 15 percent and 30 percent of sensitive and non-sensitive fish habitat would be removed, respectively. Lake water level fluctuations can impact oxygen levels, habitat availability, and nutrient and food resource availability. Additionally, there is the danger of uptake of fish into the pumping system (Cott et al. 2008). For additional information on current liquid-water availability in the planning area versus typical requirements for post-lease oil and gas activities, refer **to Section 3.2.11**, Water Resources.

Indirect Habitat Alteration: Water Quality

Activities that could affect water quality would occur during the exploration, development, and production phases of oil and gas programs and include the following:

- Water withdrawal from lakes or streams for ice roads, water supply, dust suppression, and other uses
- Seawater treatment plant discharge to marine waters
- General construction in or near waterbodies
- Vehicle traffic on gravel infrastructure
- Gravel mining

Future water withdrawal from lakes in the winter could temporarily alter lake water chemistry (until spring breakup and recharge) by depleting oxygen, increasing solutes, and changing pH and conductivity. Dewatering may also increase the rate of oxygen depletion in lakes, which are increasingly depleted of oxygen during the 8 months of ice cover (Leppi et al. 2015). Reducing water quantity in a lake during the winter can increase the salinity of the water beneath the ice.

Construction or gravel mining that disturbs soils can increase sediment runoff, turbidity, and contaminant concentrations in streams. During future construction or mining, this would have a short-term adverse effect on aquatic habitats and species around or immediately downstream of soil-disturbing activities. Fugitive dust from vehicle traffic could also increase local turbidity in streams around gravel infrastructure. Dust effects on water quality would be long term and adverse.

In the event that sufficient water resources are not available in any particular portion of the NPR-A, a seawater treatment plant could be constructed to supply the surplus water needed for drilling and water flooding (**Appendix B**, **Section B.5**). Discharge from a seawater treatment plant, such as brine, filter backwash water, and rinse/cleaning water, could cause water quality alterations, such as increased salinity and reduced DO, in the waterbody in which it is being discharged. Alterations would be highest at the discharge point before mixing can occur and would alter habitat conditions for aquatic species, potentially displacing them from discharge areas. Effects of brine discharge may be highest in the winter when freshwater may be frozen. Effects would be particularly pronounced if the discharge was in the brackish lagoon waters that are hypersaline in winter.

Disturbance or Displacement: Noise and Human Activity

Oil and gas activities involving noise and human activity impacts include seismic surveys (use of vibroseis to image the subsurface) during the exploration phase, as well as gravel mining (dredging or explosives), and pile driving for bridges or vertical support members during the development and production phases.

Much of the NPR-A has been covered by 2-D seismic surveying and future 3-D seismic surveys are expected to be at the lease block level (small scale). Future seismic exploration is proposed to occur during winter (BLM 2012). Seismic surveys generate increased sound pressures in waterbodies. The high-intensity acoustic energy produced by seismic surveys can damage auditory sensory hair cells in fish, reducing their ability to hear (McCauley et al. 2003; Popper 2003; Smith et al. 2004). Underwater shock waves can also injure the swim bladder and other organs and tissue, which could injure or kill fish. Increased sound pressures in unfrozen springs in winter could stress fish because they would not have alternate habitats where they could move to avoid effects; thus, seismic surveys could disturb, injure, or kill fish in unfrozen waterbodies (springs) in the winter. Vibroseis rigs operating on the ice overhead can create sound pressures approximately 33 feet from the source great enough to cause avoidance behavior in fish (Greene 2000 and Nyland 2002, as cited in BLM 2012). While vibroseis has been shown to cause disturbance/avoidance effects in fish, the impacts are thought to be minimal when careful seismic survey guidelines are followed (Morris and Winters 2005). These guidelines include limiting seismic efforts to short duration episodes, avoiding fish overwintering areas as much as possible, and avoiding work on waterbodies with sensitive fish species (e.g., subsistence salmonids). ROP 14 specifically requires that the guidelines by Morris and Winters (2005) be followed. Effects of vibroseis are further detailed in BLM (2012) and USACE (2018).

Noise generated by vehicles and machinery as well as shipping/use of marine barge routes in the future could have potential local impacts on fish, such as disturbance, displacement, and stress-induced fleeing related to loud noises. Fish have been found to exhibit avoidance behaviors when confronted with noisy vessels—refer to Chapter 4 of the NPR-A/IAP EIS (BLM 2012) for more information on noise impacts on fish.

Noise associated with vehicles and machinery would be greatest during construction but would occur to a lesser degree throughout the program area during the life of any development project. Because most construction would occur in the winter when waterbodies would have ice cover, noise effects on fish would be reduced during that time. Noise associated with shipping activity (or even onshore activities resulting in noise being projected to offshore environments) may result in increased stress cortisol levels, inhibit intraspecies communication, and even contribute to hearing loss in fish (Thomsen et al. 2006; Vasconcelos et al. 2007). These effects may be more pronounced in areas with alternating sound wave amplitude and frequency (i.e., quiet followed by loud noises) versus areas with continuous noise (Wysocki et al. 2006). The hypothetical RFD scenario suggests the potential for a barge landing and storage pad at Atigaru Point, Smith Bay, or Utqiaġvik, with supplies being transported from Dutch Harbor in Unalaska, Alaska, in the Aleutian Island chain (**Appendix B, Map B-2**).

Injury or Mortality: Noise

Oil and gas activities that generate noise and could affect fish and aquatic species include seismic surveys (use of vibroseis to image the subsurface), gravel mining (dredging or explosives), and pile driving for bridges or vertical support members. Impacts from seismic surveys would mainly occur during the exploration phase while gravel mining and pile driving would mainly occur during development and production.

As described above in Noise and Human Activity, noise can disturb fish and, at higher decibels levels or in greater intensity, can injure or kill fish. Restricting seismic surveys to winter when waterbodies are frozen and avoiding areas around springs would minimize effects on fish.

Pile driving can also create sound levels that affect fish. Assuming that piles would be installed in winter, if the bridge or vertical support member sites freeze to the bottom, the ice would diminish the sound, and the potential impact on fish in any adjacent overwintering habitats would be negligible.

Entrainment[5]

Oil and gas activities that could cause effects related to entrainment include gravel mining and water withdrawal from lakes or streams or from marine waters, such as a seawater treatment plant. These activities would occur during development and production.

Though injury or mortality of fish from entrainment or impingement[6] at water intake could occur, the effect would be reduced by B-2/ROP B-2, which requires that any water intake structures in fish-bearing or non-fish-bearing waters be designed, operated, and maintained to prevent fish entrapment, entrainment, or injury. All water withdrawal equipment must be equipped with and use fish screening devices approved by the Alaska Department of Fish and Game, Division of Habitat. E-14/ROP E-6 would help ensure the passage of fish at stream crossings. As is described in BLM 2012, it is unlikely that fish would be entrained in the water intake.

Contaminant Spills

Post-lease oil and gas activities that could result in contaminant spills would mainly occur during the production phase of the post-leasing program. Activities include potential spills from storage, use, and transport of waste and hazardous materials, potential spills from wells, pipelines, or other infrastructure, and mobilization of contaminants into aquatic or terrestrial systems from erosion, fugitive dust, and permafrost degradation. A-4/ROP A-4 objectives would be to minimize the impact of contaminants on fish, wildlife, and the environment from spills; however, any potential spill would have serious adverse effects on fish and aquatic species. As described in detail in BLM (2012), spills can adversely affect aquatic habitats and species by exposing them to contaminants. Spills can injure or kill fish and effects can be long- or short-lived depending on the type, size, duration, and season of the spill. See **Section 3.2.12 and Appendix I** for more discussion of spills.

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[5] Unintended passage of fish through a water intake, usually caused by an absent or inadequate screen surrounding the water intake

[6] Physical contact of a fish with a barrier (e.g., screen) around a water intake due to too-high intake velocities

Abandonment and Reclamation

Objectives under G-1 Lease Stipulation would be to ensure long-term reclamation of land to its previous ecosystem function and use or as nearest affected community prefers. Prior to final abandonment, land used for oil and gas infrastructure—including but not limited to well pads, production facilities, access roads, and airstrips—shall be reclaimed to ensure eventual restoration of ecosystem function. However, impacts resulting in permanent loss of aquatic habitat through the placement of fill or excavation are not expected to recover naturally and thus, specialized treatments will be proposed to recover some ecological function (NRC 2003).

Activities Not Associated with Oil and Gas

Impacts from activities not related to oil and gas development are summarized in Section 4.3.7.1 of the 2012 IAP/EIS (BLM 2012).The types of impacts associated with non-oil and gas activities are of a similar type as those described for oil and gas activities (e.g., habitat loss or alterations, disturbance or displacement, and injury or mortality); however, the magnitude and geographic extent of these impacts would be smaller than those impacts associated with oil and gas activities because the activities would generally be of lower intensity and occur over a smaller area. The types of activities that could cause these impacts include cleanup activities at former defense sites, use of off-road vehicles (wheeled or tracked), road construction and housing associated with community infrastructure projects (e.g., NSB Comprehensive Plan 2019), activities associated with scientific research (e.g., camps), subsistence activities (e.g., increased hunting pressure from new road access), sight-seeing, hunting activities and other increased tourist activities (e.g., increased human activity, potentials for spills from aircraft and outstandingly remarkable value traffic). These types of impacts would range from temporary (cleanup sites) to permanent (new community infrastructure) depending on the extent and duration of the activities.

Climate Change

The effects of climate change described under the *Affected Environment*, above, are part of the baseline conditions for fish in the project. See **Section 3.2.1** for a detailed discussion of the alternatives' contributions to global climate change.

Alternative A

Alternative A is the no action alternative. NPR-A lands and associated waters will continue to be managed under the 2013 NPR-A ROD, subject to BMPs listed in **Chapter 2 Table 2-2**. Leases may be sold and developed under the 2013 ROD in accordance with the Naval Petroleum Reserves Production Act, which requires the BLM to manage the NPR-A for exploration and development. With this in mind, we acknowledge that the most beneficial actions that preserve fish and aquatic resources in their natural state are those that prohibit or limit development activities.

Nearly 11 million acres are closed to fluid mineral leasing under Alternative A (**Appendix L**, **Table L-3**). This includes 3,218,000 acres in the Coastal Plain Unit (no closure in the Lower Colville Unit). A total of 2,489,000 acres in those same two habitat units are open to some conditional degree of fluid mineral development (NSO). Under Alternative A, 974 miles of known Anadromous Waters Catalog waters are closed to fluid mineral development (**Appendix L**, **Table L-4**). Another 825 miles of known Anadromous Waters Catalog are open to fluid mineral development but subject to NSO stipulations. A total of 34 miles of saffron cod and 506 miles of Arctic cod essential fish habitat are designated along the coastline and are closed to fluid mineral development.

The BLM currently considers permitting sand and gravel mining in the entire decision area. Unlike other alternatives, known Anadromous Waters Catalog waters and essential fish habitat coastline are open to sand and gravel mining for sand and gravel on a case-by-case basis under Alternative A. Impacts from gravel mining as described above under *Impacts Common to All Alternatives* could occur in any Anadromous Waters Catalog waters and essential fish habitat coastline.

Infrastructure development is unavailable on 224 miles of known Anadromous Waters Catalog waters and 80 miles of essential fish habitat designated waters under Alternative A (**Appendix L, Table L-5**), with limited essential infrastructure development (e.g., pipelines, roads, and coastline barge landings and seawater treatment plant) allowed for another 1,196 miles of known Anadromous Waters Catalog waters and 412 miles of coastal essential fish habitat waters. Infrastructure development is available for 722 miles of known Anadromous Waters Catalog waters and 75 miles of essential fish habitat designated coastline. Infrastructure development is completely unavailable in 998,000 acres of land within the Coastal Plain fish habitat unit (**Appendix L, Table L-6**). However, some level of conditional infrastructure development is allowed in 9,093,000 acres of the Coastal Plain and Lower Colville fish habitat units combined.

Within deep lake (1.6–4 meters) and very deep (lake>4 meters) habitat, fluid mineral development is closed or designated NSO for an additional 827,000 acres (**Appendix L, Table L-7**). Infrastructure development is allowed near 925,000 acres of deep- and very deep lake-habitat (**Appendix L, Table L-8**). A total of 320,000 acres of deep or very deep lake-habitat are closed to infrastructure development with another 78,000 acres unavailable expect for essential development activity (**Appendix L, Table L-8**). As with rivers and streams, sand and gravel mining are allocated on a case-by-case basis for lake-habitat under Alternative A.

Based on the projections presented in **Appendix B, Table B-9**, the surface disturbance from gravel mining in the high development potential zone under Alternative A is expected to be 89 acres, 130 acres, or 236 acres for the theoretical low, medium, or high development scenarios, respectively, and the surface disturbance from gravel fill is expected to be 530 acres, 782 acres, or 1,375 acres for the theoretical low, medium, or high development scenarios, respectively.

Alternative B

Under Alternatives B–D, the BLM would consider permitting sand and gravel mining in the entire planning area with the exception of the Fish Creek three-mile setback downstream from the eastern edge of Section 31, T11N, R1E, U.M. This area would be closed to sand and gravel mining under all action alternatives so that direct impacts to fish and habitat in this area would be avoided. The Fish Creek drainage overlaps with the Lower Colville and Coastal Plain fish habitat units.

More acres (11,335,000 total) are closed to fluid mineral leasing under Alternative B than under Alternative A across all fish habitat units, which represents a three percent increase in habitat protections (**Appendix L, Table L-3**). Significantly more acres (3,855,000 total) are closed to fluid mineral leasing in the Coastal Plain fish habitat unit, though as is with Alternative A, none are closed to fluid mineral leasing in the Lower Colville unit. Additionally, there is a 23 percent increase in known Anadromous Waters Catalog stream miles closed to fluid mineral development under Alternative B (**Appendix L, Table L-4**). There is a 14 percent decrease in known Anadromous Waters Catalog stream miles that are open to fluid mineral development under NSO conditions compared to Alternative A, and thus a reduction in impacts as described under *Impacts Common to All Alternatives*.

A total of 2,147 miles of known Anadromous Waters Catalog waters are open to sand and gravel mining, while just 70 miles of known Anadromous Waters Catalog waters are closed to sand and gravel mining in alternatives B–D. Conversely, sand and gravel mining values are taken on a case-by-case basis for Alternative A.

New infrastructure development is closed on 1,050 miles of known Anadromous Waters Catalog waterbodies, a 369 percent increase in habitat protections over Alternative A (**Table L, Table L-5**), providing likely additional protections in known fish habitats. Furthermore, there is a 39 percent decrease in known Anadromous Waters Catalog streams that are conditionally open to essential infrastructure development under Alternative B. Overall, there is an ~50 percent decrease (364 down from 722) in known Anadromous Waters Catalog stream miles that are open for new infrastructure under Alternative B. New infrastructure is completely unavailable in 3,499,000 acres in the Coastal Plain fish habitat unit, an increase of 250 percent over Alternative A (**Appendix L, Table L-6**). However, slightly more conditional infrastructure development is allowed overall under lands of Alternative B (10,090,000 acres) versus Alternative A (9,093,000 acres).

A total of 939,000 acres of deep and very deep lake habitat are closed or designated NSO for fluid mineral leasing, an increase in protected deep lake habitat of 14 percent over Alternative A (**Appendix L, Table L-7**). There is a 52 percent decrease in deep and very deep lake habitat available for infrastructure development under Alternative B. In total, 804,000 acres of deep and very deep lake habitat are closed to infrastructure development, an increase of 151 percent over Alternative A (**Appendix L, Table L-8**).

Based on the projections presented in **Appendix B, Table B-9** the surface disturbance from gravel mining in the planning area under Alternative B is expected to be 80 acres, 117 acres, or 212 acres for the theoretical low, medium, or high development scenarios, respectively. Similarly, the surface disturbance from gravel fill in the planning area under Alternative B is expected to be 476 acres, 703 acres, or 1,236 acres for the theoretical low, medium, or high development scenarios, respectively. These acreage figures are all slightly less than under Alternative A.

Alternative C

Under Alternative C, only 5,701,000 acres are closed to fluid mineral leasing across all habitat units, a 48 percent decrease compared to Alternative A (**Appendix L, Table L-3**). As is the case with Alternative B, there are no acres closed to fluid mineral leasing in the Lower Colville fish habitat unit under Alternative C. A total of 1,071,000 acres are closed to fluid mineral leasing in the Coastal Plain unit, a decrease of 67 percent compared to Alternative A. Only 309 miles of known Anadromous Waters Catalog streams are closed to fluid mineral development, a 68 percent decrease in stream habitat protections (**Appendix L, Table L-4**). Conversely, 1,366 miles of known Anadromous Waters Catalog stream are open to fluid mineral development, an increase of 70 percent over the no action alternative.

Under Alternative C, infrastructure development is closed on 268 miles of known Anadromous Waters Catalog waterbodies, an increase in protections to fish habitat of 20 percent over Alternative A (**Appendix L, Table L-5**). However, there is a slight decrease (less than 1 percent) in Anadromous Waters Catalog streams that are completely available to infrastructure development as well as a decrease in conditional availability (3 percent) for essential infrastructure development under Alternative C versus the no action alternative. Furthermore, there is a 6 percent decrease in lands completely closed to infrastructure development in the Coastal Plain fish habitat unit under Alternative C (**Appendix L, Table L-6**).

Within deep or very deep lake-habitat under Alternative C, fluid mineral development is closed or designated NSO for 792,000 acres, a decrease in protected deep lake habitat of 4 percent from Alternative A (**Appendix L, Table L-7**). A total of 313,000 acres of deep lake habitat are closed to infrastructure development under Alternative C, a 2 percent decrease in potential protections from infrastructure impacts compared to Alternative A (**Appendix L, Table L-8**).

Based on the projections presented in **Appendix B, Table B-9** the surface disturbance from gravel mining in the high development potential zone under Alternative C is expected to be 112 acres, 164 acres, or 297 acres for the theoretical low, medium, or high development scenarios, respectively, and the surface disturbance from gravel fill is expected to be 669 acres, 987 acres, or 1,736 acres for the theoretical low, medium, or high development scenarios, respectively. These acreage figures all represent increases relative to Alternative A.

Alternative D

Under Alternative D, 4,429,000 acres of land (the fewest of all alternatives) across all fish habitat units are closed to fluid mineral leasing (**Appendix L, Table L-3**). This is a 60 percent decrease from Alternative A. Only 61,000 acres of Coastal Plain Unit land are closed to fluid mineral leasing under Alternative D, a 98 percent decrease from protections provided under Alternative A. A total of 214 miles of Anadromous Waters Catalog waterbodies are closed to fluid mineral development, a 78 percent decrease in protections compared to Alternative A (**Appendix L, Table L-4**). Another 1,262 miles of Anadromous Waters Catalog streams are open to fluid mineral development but with NSO provisions, an increase of 53 percent over Alternative A.

Infrastructure development is closed on 189 miles of known Anadromous Waters Catalog stream habitat, a decrease of 16 percent compared to Alternative A (**Appendix L, Table L-5**). Infrastructure development is allowed on 780 miles of Anadromous Waters Catalog streams (up 8 percent over Alternative A) and conditionally allowed for essential development on another 1,173 miles (down 2 percent). New infrastructure development is not allowed on 347,000 acres of the Coastal Plain fish habitat unit, though as with other alternatives, it is allowed in the Lower Colville River unit (**Appendix L, Table L-6**). Some level of conditional infrastructure development is allowed on 9,744,000 acres of the Lower Colville River unit and Coastal Plain unit combined.

Within deep or very deep lake-habitat under Alternative D, fluid mineral development is closed or designated NSO for 586,000 acres, a decrease in protected deep lake habitat of 29 percent from Alternative A (**Appendix L, Table L-7**). A total of 227,000 acres of deep lake habitat are closed to infrastructure development under Alternative D, a 29 percent decrease in potential protections from infrastructure impacts compared to Alternative A (**Appendix L, Table L-8**).

Based on the projections presented in **Appendix B, Table B-9** the surface disturbance from gravel mining in the high development potential zone under Alternative D is expected to be 154 acres, 225 acres, or 409 acres for the theoretical low, medium, or high development scenarios, respectively, and the surface disturbance from gravel fill is expected to be 919 acres, 1,356 acres, or 2,385 acres for the theoretical low, medium, or high development scenarios, respectively. These acreage figures all represent substantial increases relative to Alternative A.

Traditional Knowledge

Traditional knowledge is an important resource for describing past and current conditions of fish and aquatic resources in the planning area. Interviews conducted with subsistence fishers in the 6 villages within the planning area dating to the mid-1970s have provided invaluable local knowledge related to fish and their habitat, their life-history, their diet, migratory patterns and timing, preferred subsistence fishing locations for each species, and changes in fish condition and harvest patterns following exploration and development activities (**Appendix Y**, **Section 3.1.4**). Insights gained from these interviews represent not only an additional resource critical to describing the current state of fish and aquatic resources for the planning area, but may also inform our understanding of the potential direct and indirect impacts by alternatives for this IAP, and the cumulative impacts of foreseeable development scenarios on fish and aquatic resources.

Cumulative Impacts

The geographic area considered for cumulative impacts includes the North Slope of Alaska and the near-shore marine environment (adjacent nearshore waters in the Beaufort and Chukchi seas), and the foothills of the Brooks Range. With the foreseeable addition of a shipping lane in marine waters linking the Beaufort Sea Coastline with Dutch Harbor (**Appendix B, Map B-2**), the geographic area in marine waters would extend to include the Bering Sea and nearshore environments of the Aleutian Islands. The time frame for the analysis includes all past and present (existing) developments in these areas that extends from the 1970s through 70 years from the ROD. This is a reasonably foreseeable time frame given the pace of development past and present, and the fact that most oil and gas development projects can be in production from 10 to 50 years (**Appendix B, Section B.1**).

Past and present projects within the planning area, and thus managed under the existing 2012 IAP/EIS (BLM 2012), were discussed briefly in the *Affected Environment* section above. These include the Colville Delta-5 and GMT1 satellite fields of the Alpine Development. In addition to those projects under current operations, the GMT2 and Willow projects represent similar oil and gas developments in the reasonably foreseeable future that are within the management boundaries of the planning area. The Umiat and Smith Bay fields are reasonably foreseeable longer-range oil and gas developments within the larger 70-year time frame described above. However, because Umiat exploratory wells were drilled in the 1940s, cumulative impacts for these resources must be assessed from the 1940s through 70 years beyond the ROD for past and reasonably foreseeable events. Activities associated with these projects would contribute to impacts on fish and habitat associated with development (e.g., disturbance, habitat loss, or degradation) and cumulatively would increase the area of fish habitat impacted.

Also within the planning area are potential sand and gravel mining and/or road development projects that may be part of the planning agendas of the NSB, local village governments, or the oil and gas industry (e.g., NSB Comprehensive Plan and Umiat Roads). The expansion of ice road development to (seasonally) connect communities and industry to established infrastructure resources is reasonably foreseeable and will require significant additional water resources for their development. Water resources are typically abundant throughout much of the planning area. Nevertheless, withdrawals will likely contribute to direct and indirect and cumulative impacts to fish and aquatic habitat, though these waters will be subject to permitting for withdrawal purposes. Should freshwater resources not be sufficient for any given project, seawater treatment plants may be required in coastal marine environments to support ice road and oil and gas activities in the planning area.

Beyond the boundaries of the planning area, Point Thomson, the Greater Prudhoe Bay/Deadhorse Area, and the Kuparuk River field are all operational and are likely to continue to contribute additive direct and indirect cumulative effects of oil and gas development on fish and aquatic resources, as described in the *Impacts Common to All Alternatives* section above.

RFFAs in the cumulative impacts analysis area include the Nanushuk field, Alaska LNG pipeline, ASAP, and the SAE 3D seismic survey in the ANWR. In addition to the larger oil and gas projects, there are existing and reasonably foreseeable community infrastructure projects, scientific research camps, and subsistence impacts, as described in the *Impacts Common to All Alternatives* section above. Comprehensive aquatic mapping data are not available for all the RFFAs to facilitate a meaningful quantitative analysis of the cumulative loss or impact to fish and aquatic habitats; however, all listed developments will contribute additive cumulative impacts to existing and proposed developments within the planning area.

Lease stipulations and ROPs are designed to provide protections to aquatic resources so that complete loss of aquatic habitat is minimized and is not permanent. Still, the potential for alteration to or direct loss of aquatic habitat is foreseeable depending on the degree of development under any alternative. As stated previously, the areas of highest development likelihood are also areas of significant fish and aquatic habitat, and include many corridors for anadromous fish movement. Climate change will also contribute to cumulative impacts, including changes in stream hydrologic regimes (e.g., ground and surface water flow patterns), lake numbers, depths, and volumes, as well as changes to coastal lagoon and bay ecosystems (e.g., salinity, nutrient inputs, food and refuge availability), all of which will impact fish resources.

Of the action alternatives, Alternative B would provide the most protection for existing fish and aquatic resources within the planning area. There are greater restrictions to fluid mineral leasing, infrastructure development and sand and gravel mining under Alternative B than all other alternatives, including within the high development potential zone where the Lower Colville River and Coastal Plain fish habitat units are located. Alternative D would provide the least protection to fish and aquatic resources in the planning area.

The effects of climate change described under *Affected Environment*, above, could influence the rate or degree of the potential cumulative impacts discussed here.

3.3.4 Birds

Approximately 90 species of birds could occur in the NPR-A (BLM 2012, Section 3.3.5) and the nearshore waters of the Beaufort and Chukchi seas (see **Appendix N** for common, Inupiaq and scientific names, abundance descriptors, and conservation status). The area of analysis includes all terrestrial areas within the NPR-A borders and 5 miles off shore to include the sand spits, lagoons, nearshore islands, such as Cooper Island and nearshore marine waters (**Appendix A, Map 3-1**). Most species are migratory breeders that winter in other parts of Alaska, other states, or other countries and continents. Although breeders predominate, many other species pass through or stage in NPR-A on their way to or from other breeding locations.

Coastal areas in NPR-A provide substantial numbers of waterfowl, seabirds, and shorebirds with molting and fall-staging areas. The largest proportion of aquatic birds (waterfowl, loons, grebes, shorebirds, gulls, terns, and jaegers) on the Arctic Coastal Plain occurred in the NPR-A during aerial and ground-based plot surveys, respectively (84 percent and 69 percent) (Bart et al. 2013). NPR-A contains six Important Bird Areas designated for continental or global importance by Audubon Alaska (2015): the Lower Colville River, Colville River Delta, Teshekpuk Lake Area, Beaufort Sea Nearshore, Barrow Canyon and Smith Bay (combined), and Chukchi Sea Nearshore (**Appendix A, Map 3-18**).

The Teshekpuk Lake Special Area comprises 18 percent of the NPR-A yet supports 53 percent of the aquatic birds in NPR-A and 42 percent of the aquatic birds on the Arctic Coastal Plain (Bart et al. 2013). The few year-round residents include willow and rock ptarmigan, common raven, gyrfalcon, and snowy owl, some of which may migrate to alternative wintering areas in some years (Johnson and Herter 1989).

Detailed information on individual species and species groups is provided in the 2012 NPR-A IAP EIS (BLM 2012, Section 3.3.5) and is incorporated here by reference.

Substantial new information that became available since the 2012 IAP was prepared is available on populations, trends, distribution, and important areas for most species counted on Arctic Coastal Plain breeding population aerial surveys (Wilson et al. 2018; Amundson et al. 2019) and from ground-based surveys (Andres et al. 2012; Bart et al. 2013; Johnson et al. 2017). All species are protected by the Migratory Bird Treaty Act (16 USC 703 et seq.), designated species are protected by the ESA of 1973 as amended (16 USC 1531 et seq.), and eagles are protected by the Bald and Golden Eagle Protection Act (16 USC 668–668d).

Additionally, BLM adopted specific management guidelines for NPR-A in BMPs for spectacled and Steller's eiders, breeding yellow-billed loons, and nesting raptors (BLM 2013). Below are reported average population estimates and growth rates for the latest 10-year period (2008–2017) and long-term growth rates over 25 (1992–2016) or 32 years (1986–2017) from breeding bird aerial surveys conducted on the Arctic Coastal Plain (Wilson et al. 2018). Ten-year estimates of population size are reported rather than single-year estimates (latest available is for 2017), because of high variability in annual counts. These population estimates and trends update those presented for the previous IAP in 2012 (BLM 2012, Section 3.3.5).

Special Status Species

Numerous agencies and groups maintain lists of birds with special conservation status (**Appendix N**). This section focuses on species that are threatened or endangered under the ESA, listed by BLM as Sensitive Animals in Alaska (BLM 2019b), or listed by U.S. Fish and Wildlife Service (USFWS) as Birds of Conservation Concern in Bird Conservation Region 3 (Arctic plains and mountains), which includes NPR-A (USFWS 2008). Two species of seaducks breeding in the NPR-A, the spectacled eider and the Alaska breeding population of Steller's eider, are listed as threatened species under the ESA (58 FR 27474 and 62 FR 31748, respectively). Spectacled eiders have a stable to decreasing population trend (mean growth rate is negative, but 95 percent CI bounds 0, or no change) on the Arctic Coastal Plain, with a 10-year average of 6,246 total indicated birds (2008–2017; Wilson et al. 2018). Spectacled eiders breed on the Yukon-Kuskokwim Delta and on the Arctic Coastal Plain from Icy Cape to the Shaviovik River (66 FR 9146). Critical habitat has been designated for spectacled eiders nesting on the Yukon-Kuskokwim Delta, molting in Ledyard Bay and Norton Sound, and wintering south of St. Lawrence Island, where Alaska and Russia breeding birds winter.

The NPR-A supports about 88 percent of the Arctic Coastal Plain population of spectacled eiders, based on density estimates (**Appendix A, Map 3-12**). About 15 percent of the Arctic Coastal Plain population are located in the Teshekpuk Lake Special Area. Besides ESA protections, both spectacled and Steller's eiders must have 3 years of pre-breeding aerial surveys, and possibly ground-based searches, prior to construction permitting, if development is proposed in their habitat; if either species is present, the applicant must coordinate with USFWS and BLM to design and site infrastructure so that impacts are minimized (BMP E-11, BLM 2013).

The Alaska breeding population of Steller's eiders is highly variable breeders, with little to no nesting apparent in some years. This is the case even in the Utqiaġvik area (Quakenbush et al. 2004), which is their primary breeding area in North America (**Appendix A**, **Maps 3-12** and **3-15**). Predation and possibly lead exposure from spent shot are identified threats in the USFWS's decision to list the Alaska breeding population as threatened (62 FR 31748).

Steller's eiders mostly breed in Arctic Russia, and most of those that breed in Russian and Alaska overwinter in Cook Inlet, along the Alaska Peninsula, and Aleutian Islands. Only a few pairs may still nest on the Yukon-Kuskokwim Delta (Flint and Herzog 1999); therefore, NPR-A supports nearly 100 percent of breeding by the listed population (**Appendix A, Map 3-15**) and on this continent. The 10-year average number on the Arctic Coastal Plain is 137 indicated total birds (Wilson et al. 2018), but numbers are highly variable. Stehn and Platte (2009) conducted a more comprehensive analysis with data from 3 different surveys with stratification and correction factors to estimate an average population of 576 Steller's eiders (90% CI = 292–859) on the Arctic Coastal Plain from 1993 to 2008. Critical habitat for Steller's eiders was designated for nesting on the YKD and post-breeding in marine zones around the Alaska Peninsula and Cook Inlet (66 FR 8850). No areas have been designated critical habitat for listed birds within the analysis area.

> *Back in, when I was beginning to be a boy, my parents, they owned a canoe. So we have to go down the coast when the, when they, after all the ice caved. We had to haul some driftwood for when, winter use, along the coastline. There used to be some, these stellar eiders just bunched up in one spot, another bunch, another bunch, in the summer months, after they nesting in the, in the, up inland. They stayed along this coastline in a big bunch, you know, in bunches, bunch, bunch. But for the last years that I have known, have seen my, personally, I haven't seen any flock along this shoreline for the last few years. I don't know what, what became of those ducks. Kenneth Toovak* (Utqiaġvik) (MMS 1982; **Appendix Y**)

There are 11 sensitive species listed by the BLM that occur in the NPR-A: spectacled and Steller's eiders, Kittlitz's murrelet, yellow-billed and red-throated loons, dunlin, red knot, bar-tailed godwit, whimbrel, buff-breasted sandpiper, and Smith's longspur (BLM 2019b). Eight of those species and two additional species were listed by USFWS (2008) as Birds of Conservation Concern: yellow-billed and red-throated loons, dunlin, red knot, bar-tailed godwit, whimbrel, buff-breasted sandpiper, Smith's longspur, peregrine falcon, and arctic tern. All of the foregoing species may breed in the NPR-A.

Among the casual breeders, the Kittlitz's murrelet occurs in small numbers in the Chukchi Sea and a few nests have been found on land, but none have been found in the NPR-A (Day et al. 2011), red knot may breed occasionally near Utqiaġvik, and Smith's longspurs may breed along the upper Colville River (Johnson and Herter 1989). The other special status species are common, uncommon, or rare but regular breeders in NPR-A.

The yellow-billed loon is the largest loon species, with a patchy breeding distribution on northern tundra in Russia, Canada, and Alaska (Earnst 2004). In Alaska, it nests from the Seward Peninsula, including St. Lawrence Island, across the Arctic Coastal Plain to approximately the Colville River, and winters in east Asia. The species prefers large, deep lakes, with complex shorelines with emergent vegetation which were typically near streams; in NPR-A, yellow-billed loons feed their young on prey captured in brood-rearing lakes (Earnst et al. 2006).

On the Colville River, 87 percent of the lakes where they breed support both nests and broods and average 237 acres in size (Johnson et al. 2019); however, they can use smaller lakes (mean = 10 acres) for nesting by moving young to adjacent large lakes (Johnson et al. 2019). Reoccupation, breeding, and retention of territories are high, and that suggests that the species is habitat limited (Schmutz et al. 2014; Johnson et al. 2019). The NPR-A supports over 75 percent of the Alaska breeding population (Schmutz et al. 2014) with concentration areas along the Meade and Chipp rivers and Fish Creek (**Appendix A, Map 3-12**).

An estimated 3,369 yellow-billed loons occupied breeding areas in northern Alaska, but fewer than 1,000 pairs probably nested (Earnst et al. 2005). Long-term, the population on the Arctic Coastal Plain has grown, but over the latest 10 years, it has been stable to decreasing (Wilson et al. 2018). The patchy distribution of yellow-billed loons and concerns for its small population (USFWS 2014) led to an intergovernmental conservation agreement (USFWS 2006) and a proposal to list the species as threatened or endangered (72 FR 31256), which was later decided to be unwarranted (79 FR 59195). The yellow-billed loon has been protected by BMP E-11, which requires 3 years of surveys for yellow-billed loon nests and for broods if development could occur within 1 mile of lakes of 25 or more acres and establishes no development buffers within 1 mile of nest sites and 1,625 feet the remainder of a breeding lake (BLM 2013).

Red-throated loons are the smallest loons of 5 loon species, breeding on small ponds and lakes on the Arctic Coastal Plain with an estimated population size of 2,490 indicated total birds (10-year average; Wilson et al. 2018). They have a circumpolar distribution but breed more commonly on tundra in northern coastal areas than in boreal or mountain regions (Gotthardt 2001). Although the population throughout Alaska had declined since the 1970s (Groves et al. 1996), the trend on the Arctic Coastal Plain has been stable to decreasing over 32 years, but stable to increasing over the last 10 years (Wilson et al. 2018). The NPR-A supports about 74 percent of the Arctic Coastal Plain population of red-throated loons, based on density estimates with (**Appendix A**, **Map 3-12**). About 15 percent of the Arctic Coastal Plain birds are located in the Teshekpuk Lake Special Area.

Arctic terns are common breeders in northern NPR-A where they tend to nest in small colonies in drained lake basins, islands in lakes and ponds, and sedge marshes (Johnson et al. 2005). They have the longest regular migration stretching some 25,000 miles from Antarctic waters to circumarctic, subarctic, and coastal breeding grounds (Hatch 2002). The 10-year average population estimate for the Arctic Coastal Plain is 21,523 indicated total birds; the long-term growth rate for arctic terns is positive, whereas over the latest 10 years, the growth rate is stable to decreasing (Wilson et al. 2018).

Dunlin (*arcticola* subspecies), bar-tailed godwit, whimbrel, and buff-breasted sandpiper are BLM listed sensitive animals (BLM 2019b) that are common to rare breeders on the Arctic Coastal Plain. Dunlin are declining worldwide with loss of winter habitat (Warnoc and Gill 1996; Warnoc 2017), but are one of the most widely distributed and common breeding species in the western Beaufort Coastal Plain (Johnson et al. 2007), including the NPR-A and Teshekpuk Lake Special Area (Andres et al. 2012, Saalfeld et al. 2013). Bar-tailed godwit and whimbrel are the largest-bodied shorebirds breeding in the NPR-A and occur at low densities in Teshekpuk Lake Special Area (Andres et al. 2012). Bar-tailed godwits are most abundant in the western Beaufort Coastal Plain and Brooks Foothills, whereas whimbrels are more abundant in the Brooks Foothills (Johnson et al. 2007) and not recorded in the Teshekpuk Lake Special Area (Andres et al. 2012). Buff-breasted sandpipers are distributed across much of the Beaufort Coastal Plain, but absent from the Brooks Foothills (Johnson et al. 2007); low densities occur in the Teshekpuk Lake Special Area (Andres et al. 2012).

The arctic peregrine falcon nests on rocky cliffs, shale banks, and steep soil bluffs along rivers and lakes (Ritchie et al. 2003, Ritchie 2014) in the Arctic and can nest on elevated human structures (Ritchie et al. 1998; Frost et al. 2007) as the species does elsewhere (White et al. 2002). The peregrine was listed as endangered in 1969 after populations were reduced by DDT contamination. The arctic peregrine falcon recovered and was delisted from threatened status in 1994 (59 FR 50796), but remained on the BLM's sensitive species list until 2019 (BLM 2019b). The Colville River Special Area (CRSA) was designated in

1977 and expanded in to 2.44 million acres in 1999 (64 FR 16747) to protect peregrine falcon nesting sites (**Appendix A, Map 3-18**).

Most of the identified peregrine falcon nest sites are in the CRSA, but nests on bluffs along lakes north and west of the CRSA, first noted in 1999, are now common and possibly the result of an expanding population (Ritchie 2014, Shook and Ritchie 2017; **Appendix A, Map 3-16**). Nesting sites were also protected by ROPs and BMPs in RODs for preceding IAPs (BLM 1998, 2004, 2008, 2013). Peregrines and other raptors are protected by BMP E-16, requiring current standards to minimize electrocution from powerlines, and BMP F-1, restricting aircraft overflights that are within 0.5 miles of identified cliff nest sites to1,500 feet, or greater, agl from March 15 to August 15 for gyrfalcon nests and April 15 to August 15 for all other raptor nests.

Waterbirds

Waterbirds is a diverse and abundant species group dependent to various degrees on freshwater lakes and ponds for nesting, brood-rearing, and molting, with some species using nearshore marine waters in the Beaufort and Chukchi Seas during breeding and post-breeding (Fischer and Larned 2004; Lysne et al. 2004).

> *Black brant, you can catch those up here [directly east of Barrow], and if you want to harvest large [amounts] you can go [here] [Wainwright area]. Black brant are not my favorite type of geese, but if I'm in the area and I can harvest them, I harvest them. When I go eider duck hunting over here [in the lagoon], the black brants sometimes fly back and forth where the eider ducks fly south. The black brants fly back and forth between feeding grounds.* (Utqiaġvik) (SRB&A 2010a)

Waterbirds includes waterfowl (ducks, geese, and swans), loons, grebes, and cranes (**Appendix N**). Among these, the following species of geese are the most abundant on the Arctic Coastal Plain and those populations have been increasing over the last 25 to 32 years in terms of 10-year average population estimates (Amundson et al. 2019; Wilson et al. 2018): greater white-fronted geese (260,142), snow geese (31,199), brant (14,251), and cackling/Canada geese (12,123). Cackling geese (*Branta hutchinsii*) overlap with Canada geese (*B. canadensis parvipes*) on northern tundra and possibly interbreed (Mowbray et al. 2002a, 2002b); here they are treated as all Cackling geese due to difficulty in identification and the nomenclature used in recent literature (e.g., Wilson et al. 2018). Tundra swans (16,022) also have been increasing.

The most abundant ducks are northern pintail (72,346) and long-tailed duck (50,654), but there is a diverse assemblage of less abundant species including king eiders (20,289) and common eiders (1,252). Northern pintails are stable to increasing, whereas long-tailed ducks are significantly decreasing over 32 years (Wilson et al. 2018). Of the four eiders breeding on the Arctic Coastal Plain, king eiders are by far the most numerous and widely distributed (**Appendix A, Map 3-12**). Aerial survey data from the Arctic Coastal Plain indicate both king and common eiders have significantly positive growth rates (Wilson et al. 2018), but other data indicate king eiders have declined (Suydam et al. 2000; Bentzen and Powell 2012). The NPR-A supports the highest densities of waterbirds and highest proportion (82 percent) of their populations of any area on the North Slope (Bart et al. 2013).

> *That's pretty much it except for on the spit, there's lots of eiders along the whole lagoon spit, lots of eiders. The whole thing; I've seen eider nests throughout the whole spit from*

> *here to Icy Cape. They don't nest too far apart, from here to the wall and there'll be a whole pod of them.* (Point Lay) (SRB&A 2011a)

The NPR-A is a major breeding and molting area for brant (**Appendix A**, **Map 3-17**) and other geese; a portion of the Teshekpuk Lake Special Area on the north and east of Teshekpuk Lake has long been recognized as a regional concentration area for molting geese (King 1970) and monitored with annual surveys since 1976 (Schultz and Zeller 2019). An estimated 22 percent of the entire brant population uses the Teshekpuk Lake Special Area during molt (Flint and Thompson 2018) and brant and other geese in the Teshekpuk Lake Special Area survey area are concentrated in a subset of the available lakes although many more are used less consistently.

> *In addition, this is also Carroll's testimony, in addition the entire area around Teshekpuk Lake is an extremely important habitat for waterfowl nesting, molting, and feeding should be excluded from leasing, exploration, and development there for that reason.* (Utqiaġvik) (BLM 2019a)

> *In addition to the area north of, this is the last page of Carroll's transcript, in the area of the lake it is extremely important for habitat of molting black (01:30:35.85) and then Nesting White Footed Geese and the construction of a pipeline could be very detrimental on these populations.* (Utqiaġvik) (BLM 2019a)

A spatial analysis of the distribution of molting brant (and other geese) performed by USGS (Flint and Thompson 2018) identified lakes used by 85 percent of the brant molting in the Teshekpuk Lake Special Area (**Appendix A**, **Map 3-19**). Brant and snow geese have a distinctly coastal distribution (**Appendix A**, **Map 3-12**), whereas greater white-fronted geese and Cackling geese are more widely distributed on the Arctic Coastal Plain. Besides brant, the Teshekpuk Lake Special Area also supports large numbers of snow geese, greater white-fronted geese, and cackling geese during the brood-rearing and molting period (Flint and Thompson 2018; Schults and Zeller 2019).

> *The area to the north and east of Teshekpuk Lake is vitally important for many molting geese. Up to 20 percent of the entire Pacific flyway population of black brant can molt in the Teshekpuk area at any one time. This is a great concern that molting birds are susceptible to disturbance and any activity in these areas has a potential to greatly reduce the population of brants and other geese. Also in the area there are relatively dense populations of king eiders which are very important again for subsistence and king eider populations have declined by about 50 percent in the last 20, 25 years. There are also many other species of waterfowl that are important in this area and we need to learn a great deal about them* (Utqiaġvik) (BLM 2003a; **Appendix Y**).

Greater white-fronted goose is the most frequently harvested bird (25,936 estimated in 2017) by subsistence hunters in Alaska and on the North Slope (7,034). Geese (8,515) surpassed ducks (5,994) in total numbers harvested on the North Slope (Naves and Keating 2018). King and common eiders were the most common species of duck in the subsistence harvest for the North Slope; an estimated 4,959 king eiders and 915 common eiders were harvested in 2017, comprising more than 98 percent of the duck harvest (Naves and Keating 2018). Swans and loons were small components of the North Slope subsistence harvest.

Pacific loons are the most abundant (10-year average = 33,960) and most widely distributed species of loon (**Appendix A**, **Map 3-12**; Johnson et al. 2005, 2019b), outnumbering brant, snow, and Canada geese and most of the species of ducks on the Arctic Coastal Plain (Wilson et al. 2018). They sometimes share breeding lakes with yellow-billed loons, but probability of use and nesting are reduced if yellow-billed loons were present or nesting (Schmidt et al. 2014); they can use deep or shallow lakes, or artificial impoundments (Kertell 1996), but tend to nest in larger lakes than do red-throated loons (Petersen 1976).

Red-necked grebes are smaller than loons and nest on floating mats of sedges or small islets in open lakes, lakes with emergents, or marshes. Low numbers (10-year average = 89 birds) and a stable to decreasing trend have been recorded on aerial surveys of the Arctic Coastal Plain (Wilson et al. 2018).

Shorebirds

Shorebirds are the most abundant group of birds in terms of numbers and species breeding and migrating through the NPR-A (**Appendix N**) that may occur in the NPR-A. Higher densities and total numbers of shorebirds use the NPR-A than other areas of the North Slope; estimates of 72 to 87 percent of all North Slope shorebirds occur in NPR-A (Bart et al. 2013). More species of shorebirds breed in the Beaufort Coastal Plain ecoregion than in the Brooks Foothills and more species breed west of the Colville River than east of the Colville River (Johnson et al. 2007). The most abundant nesting shorebirds in NPR-A are semi-palmated sandpiper, pectoral sandpiper, long-billed dowitcher, and red and red-necked phalaropes (Saalfeld et al. 2013).

In the NPR-A, the Teshekpuk Lake Special Area supports some of the highest densities of breeding shorebirds on the Arctic Coastal Plain (Liebezeit et al. 2011; Andres et al. 2012), and contains higher proportions (52–65 percent) of suitable habitat for 8 common species of shorebirds than did the NPR-A, ANWR, or the entire Arctic Coastal Plain study area (Saalfeld et al. 2013). Habitat suitability increased with proximity to the coast, lowlands, and from east to west. River deltas and coastal areas of the Arctic Coastal Plain are important feeding zones for fall-staging shorebirds preparing for migration (Andres 1989; Taylor et al. 2010); NPR-A attracts some of the highest concentrations on the Arctic Coastal Plain at Peard Bay, Point Barrow/Elson Lagoon, Cape Simpson, and Smith Bay to Cape Halkett (Taylor et al. 2010).

Raptors

The NPR-A provides nesting sites and foraging areas for gyrfalcons (Swem et al. 1994), rough-legged hawks, and golden eagles (Ritchie 2014; Shook et al. 2018), northern harriers, and in some years for short-eared and snowy owls. Gyrfalcons, rough-legged hawks, and small number of golden eagles nest along the rivers in the foothills of the Brooks Range (Shook et al. 2018). Gyrfalcons and rough-legged hawks also will nest on human modified habitat and structures (Ritchie 1991). Snowy owls and short-eared owls are nomadic tundra nesting owls whose distribution and breeding depends on small mammal abundance (Holt et al. 2015; Wiggins et al. 2006). Their nests are abundant in years with high populations of voles and lemmings, and nearly absent in other years. The lakes region north of the foothills is used for foraging by these species.

These species plus bald eagles and merlins forage in the NPR-A, often at great distances from nesting habitat (Ritchie 2014) and a disproportionate number of juvenile golden eagles spend summer foraging in and north of the Brooks Range, including the NPR-A (McIntyre et al. 2008). All raptors are protected by E-16, requiring current standards to minimize electrocution from powerlines, and gyrfalcons are specifically protected by F-1, restricting aircraft overflights that are within 0.5 miles of identified nest sites to 1,500 feet, or greater, agl during March 15 to August 15.

Landbirds

Passerines (songbirds), ptarmigan, and the sandhill crane together are numerically abundant, but compared with other avian groups, comprise fewer species that regularly breed in the NPR-A (**Appendix N**) that may occur in the NPR-A. Lapland longspur nests outnumbered nests of any of the passerine and shorebird species in the Teshekpuk Lake Special Area (Liebezeit et al. 2011) and northeastern NPR-A (Johnson et al. 2005), and were almost as abundant as all shorebirds combined. Savannah sparrow is a regular but uncommon tundra nesting songbird. Common and hoary redpolls, eastern yellow wagtail, and American tree sparrow are uncommon to rare species nesting more often in shrubby areas. The snow bunting is uncommon, nesting in rock crevices and cavities, in debris and cracks on tundra, and frequently nesting around communities and industrial sites using human-made structures such as pipeline VSMs and crevices in buildings and facilities (Montgomerie and Lyon 2011).

The common raven nests in natural sites similar to cliff-nesting raptors, but also uses artificial structures such as bridges, towers, abandoned well-heads, and buildings, which attracts them to oil development (Day 1998; Powell and Bachensto 2009). Like glaucous gulls, they acquire supplemental food from human sources, but also feed on bird eggs and young as well as small mammals. Although not large in numbers on the Arctic Coastal Plain (10-year average = 335 indicated total birds), their population is stable to increasing over the last 32 years (Wilson et al. 2018).

Other passerines perch and nest in medium to tall shrubs in the foothills region and along streams. Willow and rock ptarmigan are year-round residents, which allows subsistence harvest of moderately high numbers on the Arctic Coastal Plain (1,518 in 2017) year-round (Naves and Keating 2018). Sandhill cranes are widely dispersed rare breeders on the Arctic Coastal Plain and harvested by local residents in small numbers (estimated 43 birds, Naves and Keating 2018). The sandhill crane is a dispersed nester in wet sedge meadows and marshes of lowland tundra (Gerber et al. 2014) of the Arctic Coastal Plain. The population on the Arctic Coastal Plain (10-year average = 577 birds) has grown 7 percent annually over 32 years (Wilson et al. 2018).

Seabirds

Seabirds, primarily gulls, terns, and jaegers, but also two alcids, are breeders and visitors in NPR-A. The larids—glaucous gull; Sabine's gull; arctic tern; and parasitic, pomarine, and long-tailed jaegers—are common to uncommon breeders. The black guillemot, an alcid, is a rare breeder (**Appendix N**) in the NPR-A. Black guillemots are relatively rare in numbers in NPR-A, where they nest primarily under human-made debris on offshore islands in the along the Chukchi and Beaufort sea coasts (Divoky et al. 1974; Butler and Buckley 2002). Several other alcids and gulls may be occasional visitors along the coast and marine waters of NPR-A. Gulls nest on offshore islands, on shorelines and islets of freshwater lakes, and in marshy areas.

Glaucous gulls are the most numerous seabird on the Arctic Coastal Plain (10-year average = 27,491 birds) and display significant population growth over the most recent 10- and 26-year periods (Wilson et al. 2018). They feed on fish, invertebrates, small mammals, berries, and carrion, and supplement their diets with anthropomorphic foods and foraging in landfills and trash receptacles where accessible (Weiser and Gilchrist 2012). Glaucous gulls nesting near Prudhoe Bay obtained a large proportion (46–85 percent) of their diet from human sources (e.g., garbage), whereas gulls nesting in other areas (including Alpine and Utqiaġvik) relied more on birds, mammals, fish and invertebrates (0–25 percent of diet was garbage; Weiser and Powell 2010). Importantly, there was a correlation between number of young fledged and percent occurrence of garbage in diets during chick rearing, suggesting garbage improved chick production.

Gulls are an abundant predator of birds and eggs, exerting negative pressure on tundra nesting birds (Day 1998). Jaegers are less numerous (10-year average = 8,682 birds of all jaeger species) and their populations are stable over 32 years and stable to decreasing over the most recent 10 years (Wilson et al. 2018). On breeding grounds, jaegers as a group feed on small mammals, but along with glaucous gulls, may adversely affect tundra bird productivity by preying on eggs and chicks. Sabine's gulls feed on aquatic invertebrates and nest along the coast of northern and western Alaska in marshy areas, wetland complexes, and lowland wet tundra near water (Day et al. 2001). Sabine's gulls are uncommon breeders on the Arctic Coastal Plain 10-year average = 14,235 birds) and their population is significantly increasing over the most recent 26 years and stable to increasing over the last 10 years (Wilson et al. 2018).

Marine Shipping Route

The approximate route for marine shipping of oil and gas modules and other materials would extend from the Beaufort Sea coast to Dutch Harbor (**Appendix A**, **Map 3-23**). The shipping route would avoid designated critical habitat for spectacled eiders in Ledyard Bay. Many of the waterfowl and seabird species listed above could encounter oceanic shipping, particularly in nearshore areas of NPR-A; these and additional species of nearshore and pelagic birds are listed separately in **Appendix O**; information on species in shipping lanes was provided in the Coastal Plain FEIS (BLM 2019c, **Appendix J**, **Table J-15**), incorporated here by reference. As many as 33 additional seabird species are present along the marine vessel route to Dutch Harbor, including albatrosses, shearwaters, petrels, larids (gulls, terns and jaegers), alcids (auklets, murres, and puffins) and cormorants (Audubon Alaska 2017) (**Appendix O**).

The federally endangered short-tailed albatross may be present in southernmost portion of the route. Short-tailed albatross is a pelagic endangered species (65 FR 46643), which could be encountered during oceanic transport in the Bering Sea. The short-tailed albatross breeds on Tori-shima, an island in Japan. No critical habitat has been designated for short-tailed albatross. The other listed species potentially encountered along the shipping route are spectacled and Steller's eiders, described above under *Special Status Species*. During post-breeding, both species could encounter shipping in nearshore waters of the Beaufort and Chukchi seas, and Steller's eiders might encounter shipping in nearshore waters of the Aleutian Islands.

Climate Change

Climate change will affect the physical and biological environment of the avian community in multiple and, in some cases, contrary ways (see **Sections 3.2.11** and **3.3.1**); positive and negative responses to climate change effects will vary among species. For a recent discussion of climate change effects, see the Coastal Plain FEIS (BLM 2019c, Section 3.3.3), which is incorporated here by reference. Mean annual temperature on the Arctic Coastal Plain has increased 1.4–1.6° C and precipitation has decreased between 1949 and 1998 (Stafford et al. 2000) (although it is predicted to increase in the future [SNAP 2011]), snow-melt occurs earlier (Stone et al. 2002), and river break-up has advanced (Ward et al. 2016). As a result, annual snow-free periods are increasing, and open-water seasons are lengthening in the Beaufort Sea.

> *I'm not sure about what kind of studies were done on the National Petroleum Reserve or how many studies or how far those studies went because it is warming up here in the Arctic and we're kind of warming up at a rapid rate up here and you know we're starting to see new species of bugs, new species of birds traveling this way* (Point Lay) (BLM 2019b).

Increasing coastal erosion and sea level rise has resulted in reductions in barrier islands and lagoons, with highest rates of erosion and accretion along the Beaufort coast between Cape Halkett and Drew Point (mean loss of 21 feet per year; Gibbs and Richmond 2017); barrier islands and the lagoons they protect provide unique and valuable nesting, foraging, and staging areas for seabirds and waterbirds (Flint et al. 2003; Martin et al. 2009; Liebezeit et al. 2012).

> *All along the coast, the whole spit is key habitat for the birds nesting, all over. Up Kukpowruk River, in all the lake areas [there are], loons, terns, everything, swans, cranes. I have never seen a crane egg but a swan egg. I saw a nest that was abandoned and they never came back.* (Point Lay) (SRB&A 2014b; **Appendix Y**)

However, river deltas may grow with sedimentation and saltwater intrusions from storms and sea level rise in combination with subsidence and sedimentation may convert coastal tundra to salt-tolerant vegetation preferred by foraging geese (Tape et al. 2013). Despite predicted increases in precipitation, increasing evaporation and transpiration, along with losses in permafrost, have resulted in decreases in areal extent and number of ponds (Andresen and Lougheed 2015) and of lakes (Hinzman et al. 2005) and this process is expected to continue although the outcome is uncertain given the complexity of interactions (SNAP 2011). Along with the potential for drier soils, shrubs will increase in height and density on the tundra and trees will advance northward (Sturm et al. 2001).

Soil, hydrology, and vegetation change is expected to occur at the scale of decades to millennia (Martin et al. 2009). These habitat changes will increase habitat quality for some songbirds but decrease habitat quality for those shorebirds and Lapland longspurs preferring moist to wet meadows (Thompson et al. 2016) and for waterfowl that rely on lakes and ponds on the tundra.

> *Phalarope. There used to be millions. You don't hardly see them any more. The whole shoreline used to be covered every time in the fall. And you don't see them inland where they nest* (Utqiaġvik) (MMS 1982; **Appendix Y**).

> *Same way with these, these little birds, snipes. Used to be in the fall, along the beach, just hundreds of it, along the beach, you know, in the ocean. But same, same thing. They're gone. Maybe you'll see one or two there, this and there, but not hundreds anymore* (Utqiaġvik) (MMS 1982; **Appendix Y**).

Warming temperatures and changing habitats may result in range extensions for some species, and range contractions for others.

> *There's some birds that don't normally come this far north, but they do nowadays. The weather warming up, they have more areas where they could raise their chicks and produce, reproduce* (Point Lay) (Braem et al. 2017; **Appendix Y**).

> *There are different waterfowl that are coming up here; they cannot be named because they are new to the region. The sand hill cranes used to be much larger and there are stories that they killed people. We have them up here I have shot them before. I didn't know what to do with them when I shot them. The one mate started circling me and it kept going up and up and it disappeared... I buried the other sandhill crane. Some of these birds must have been huge to where they could kill people* (Nuiqsut) (**Appendix Y**).

The warmer spring temperatures and longer ice and snow-free season (SNAP 2011) allows some birds to arrive and nest earlier (Liebezeit et al. 2014; Ward et al. 2016), allow production of replacement clutches and double broods in some species (Meltofte et al. 2007; Grabowsk et al. 2013; Ely et al. 2018), and may allow slow developing young of loons and tundra swans to stay on breeding grounds longer to reach flight capability. Migrant birds have arrived on the Colville River delta an average of 6 days earlier with increasing May temperatures over a 50-year period (Ward et al. 2016). For some birds, such as geese (Dickey et al. 2008) and shorebirds (Meltofte et al. 2007), warmer spring temperature results in earlier nesting and higher nesting success, although very warm temperatures and very cold temperatures tend to reduce reproductive output (Dickey et al. 2008).

> *I think [when] the weather changes, animals come early like the geese. We were trying to go by the calendar by how we used to hunt them and by the time we get there they have already gone north* (Anaktuvuk Pass) (SRB&A Unpublished-a).

Many factors affect the production of young by tundra nesting birds and trends are not consistent across species or years. Arrival and breeding of birds in the arctic may not coincide with peaks in insect production (Tulp and Schekkerman 2008) or forage quality in vegetation (Doiron et al. 2014), resulting in mismatches in timing of reproduction with forage conditions (McKinnon et al. 2012; Clausen and Clausen 2013), yet some species appear to have flexibility in timing arrival and egg laying to adjust to forage production based on local conditions (Grabowski et al. 2013; Ely et al. 2018).

Direct and Indirect Impacts

Impacts Common to All Alternatives

The impact analysis for the NPR-A IAP includes the indirect impacts from oil and gas leasing along with the direct and indirect impacts of oil and gas activities not associated with leases (e.g., seismic surveys of unleased areas and pipelines for offshore oil), and the direct and indirect impacts of non-oil and gas activities (e.g., community infrastructure construction, community transportation, and research activities). Oil and gas leases would have no direct impacts on the environment because by themselves leases would not authorize any specific activities.

The impacts of future exploration and development activities that may occur because of the issuance of leases are considered potential indirect impacts from post-lease activities including seismic and drilling exploration, construction, production and transportation of oil and gas in and from the NPR-A, and abandonment and reclamation; therefore, this analysis is of potential direct and indirect impacts on birds from on-the-ground post-lease oil and gas activities and from non-lease activities described in Chapter 2.

Potential impacts of post-lease and non-lease activities on birds fall into four major categories of effects: habitat loss and alteration, disturbance and displacement (including alteration of behavior), injury and mortality, and attraction of predators and scavengers (including both mammals and birds) to human activity or facilities, with subsequent changes in predator abundance (Eberhardt et al. 1982; Truett et al. 1997; Day 1998; Burgess 2000). The season in which activities occur would either minimize or accentuate the effects on birds. Winter activities would affect few species and low numbers of year-round residents although indirect effects on tundra could persist and affect breeding birds. Summer activities could affect breeding birds directly and indirectly during the nesting, brood-rearing, molting, and fall migration-staging seasons, when many migrant and non-migrant species are present in high numbers and potential population-level consequences of impacts are greatest.

Although many future activities, such as vehicle and air traffic, would occur for both oil and gas and non-oil and gas development, potential intensity of impacts could vary by development phase for oil and gas and by type of non-oil and gas resource development or use. For oil and gas, impact levels would vary during exploration, construction, drilling, operations, and reclamation. Exploration occurs during winter from ice pads and would have little direct effect on birds; indirect effects would occur from ice roads and rolligon traffic on tundra vegetation and from water removal in permitted water source lakes.

Human disturbance and displacement would peak during the construction phase, which involves the largest number of people, temporary construction camps, and the highest levels of vehicle, machinery, heavy-haul equipment, and aircraft traffic. Winter construction would affect the few resident birds, whereas summer construction activity could potentially affect large numbers of breeding and post-breeding birds. Habitat loss also would peak during construction, including the building of ice roads to support gravel extraction, gravel hauling, gravel road and pad construction, bridge construction, and pipeline construction. Development drilling and production activities would be restricted to gravel pads and roads and would occur year-round.

The drilling phase of a development project would require less personnel and traffic than during construction, but higher levels than during operations. Drilling and operation phases could very well overlap, as they have for the CD-5 and GMT-1/MT-6 projects. Air traffic and vehicle traffic would be higher during construction and drilling because personnel numbers and materials transport are highest during those two phases. During the operation phase, traffic rates would decline once drilling was completed.

The abandonment and reclamation phase occurs once a well pad or field is no longer producing enough oil to cover costs. Fields are predicted to produce for 10 to 50 years. Typically, abandonment and reclamation could take from 2 to 5 years following the termination of production (BLM 2012). Wells would be plugged with cement at the surface. On-site equipment, facilities, and solid wastes are removed from the site. Gravel from pads and roads would be removed and reused in other areas or placed back in the gravel mine it was extracted from. Gravel pits that are not refilled would have side slopes constructed and would be reclaimed as wildlife ponds. Pipelines and VSMs would be removed and scrapped or reused in other developments. Activity levels and types of direct and indirect impacts would probably be most similar to the construction phase of development.

For non-oil and gas activities, impacts would vary for housing, utility, or road construction and for subsistence, research, and transportation activities. Construction activity for non-oil and gas projects would have similar effects on birds as those for oil and gas development. Any expansion of housing and roads would likely increase air and vehicle traffic. The direct effects of habitat loss and indirect effects of habitat modification and disturbance would be similar to those from oil and gas, although the intensity could be less than that produced by oil and gas industrial development.

Schedules of development projects and non-lease activities in the program area are unknown, but foreseeable scenarios could have extensive overlap of exploration, construction, drilling, and operation phases of several different projects. In terms of impacts on birds, activities and areas affected would increase for years or perhaps decades after initial project construction. Three hypothetical development scenarios are described in **Appendix B**, **Section B.8**. These activities would be dispersed in different parts of the planning area available for lease over that period but are expected to be linked by roads and pipelines to the Willow and GMT2 developments to ultimately connect to the Alpine Sales Pipeline and farther east to the TAPS. Although the amount of oil and gas development potentially generated under a leasing program is unknown, three levels of hypothetical development scenarios are presented that can be applied to all the alternatives.

Habitat Loss and Alteration

Under all alternatives, winter seismic exploration and other winter activities will result in temporary and potentially some longer-term modification of avian habitats (see **Section 3.3.1**). Degradation of avian habitats by winter surface activities will be minimized under all alternatives by ROP C-2 setting standards for winter tundra travel. On a case-by-case basis, summer tundra travel for oil and gas activities can be permitted with strict requirements to protect wildlife habitat (ROP L-1). Use of off-road vehicles by local residents would not be restricted.

Tussock tundra and shrub tundra vegetation types, two of the most widespread avian habitats in the program area, are more sensitive to the physical damage caused by tundra travel and ice roads. Visible seismic lines, 10 to 35 years old, resulted in reduced abundance of four species of passerines in both upland tussock tundra and in low-center polygon habitats (Ashenhurst and Hannon 2008). Seismic lines of fewer than 1.5 years, however, did not have measurable effects on bird abundance, despite demonstrable effects on vegetation structure and composition. This is possibly because of improvements in seismic methods and practices or possibly because negative effects of seismic lines take a long time to develop, for example, thermokarsting and resulting increases in surface water may require years to decades to develop or to stabilize.

Clear long-term changes to microtopography and vegetation structure and plant species composition resulting from seismic exploration may affect the abundance and composition of bird communities and these effects would be greatest in drier upland habitats, in areas of higher microrelief, such as stream banks and ravines, and in tussock and shrub vegetation types (Jorgenson et al. 2010; Walker et al. 2019).

Additional short-term and potentially long-term habitat alteration would occur during exploration and construction phases of any specific project, which would occur primarily during winter months with the support of approved tracked vehicles as well as ice roads. In addition to exploration and construction phases, ice roads would be used during the production phase for winter pipeline maintenance, pad extensions, and other activities; ice pads could be used for material and equipment storage. Ice road and pad alignments are unavailable for calculating areas affected, but proposed use of ice roads would be extensive under all alternatives.

Ice roads and pads can interfere with natural drainage of spring runoff; additional habitat alteration can occur through vegetation damage, including reduced live and dead cover due to crushed standing plant cover, stem and blade breakage, compaction, freezing, and physical damage (see **Section 3.3.1**). Although recovery of sedges, grasses, and forbs may occur in two to three growing seasons (Pullman et al. 2005), tussocks and woody shrubs often take longer to recover (Yokel et al. 2007). Vegetation damage is most severe and takes longer to recover in well-drained areas, including moist tundra and shrub habitats, which support higher densities of passerines, ptarmigan, and some shorebirds, like whimbrel and American golden-plover. In contrast, aquatic and wet tundra habitats, which are favored by most waterbird and shorebird species (Derksen et al. 1981; Johnson et al. 2003, 2007, 2015), generally are damaged less by ice roads and recover more quickly (Guyer and Keating 2005; Pullman et al. 2005). Habitat alterations from ice roads are likely, and their impacts would be short to long term, depending on the types of vegetation affected and whether routes and pad sites are reused in multiple years.

Large water removals from lakes could have negative impacts on nesting habitats of many species of waterbirds, including loons, eiders, and other waterfowl if lakes fail to recover through annual recharge. Beginning in the exploration phase and throughout the life of a project, water withdrawal for ice roads, drilling, dust control, and potable water would occur annually. Effects may be short-term in some waterbodies, but long-term effects may occur if areas lacking abundant surface water are developed and recharge is inadequate.

Drawdown of water source lakes may reduce food availability on which birds rely and may also affect shorelines and islands; lower water levels could eliminate important nesting sites on islands and peninsulas, or make them more accessible to mammalian predators, particularly foxes. Withdrawing water from under ice could affect water chemistry and turbidity and possibly result in fish mortality and impacts on aquatic invertebrate communities (see **Section 3.3.2**). The resulting reduction in fish and invertebrates could make such lakes less suitable or unsuitable for breeding yellow-billed loons and Pacific loons, respectively. Lower invertebrate abundance, or a shift in invertebrate diversity, may affect the quality of lakes as a food source for birds in general, particularly waterbirds and shorebirds.

Under all alternatives, ROP B-2 and State of Alaska regulations would set limits on percent volume removed and other standards for summer and winter withdrawals from lakes and ponds that specifically protect bird nesting sites and fish. Despite these restrictions, water withdrawals could exceed the natural recharge rate, resulting in lower long-term water levels (see **Section 3.2.11**). The long-term loss of nesting lakes could have potential local population consequences for Pacific, red-throated, and yellow-billed loons.

In the earliest part of the development phase of any future project, gravel would be mined during winter at unidentified material sites and transported over gravel roads or ice roads or both. Some pits remaining from excavation would be used as water sources during drilling and operations. The original avian habitats would be permanently lost to material sites, but rehabilitated sites would likely be used by some species of nonbreeding, breeding, and brood-rearing waterbirds. The potential habitat loss or alteration from gravel excavation would affect 89 to 270 acres of surface disturbance depending on the development scenario and alternative chosen; the impact on birds would be long term and possibly lessened by reclamation plans (i.e., terrestrial breeding habitats could be replaced by aquatic habitats). Under all alternatives, ROP E-8 would minimize the loss of nesting habitat for cliff-nesting raptors by prohibiting removal of more than 100 cubic yards from cliffs or from an active channel and K-1 would allow gravel removal only on a case-by-case basis along streams (with restrictions) except within 3 miles of Fish Creek (**Appendix A**, **Map 2-9**), which is closed to gravel removal and infrastructure.

Potential future construction of gravel pads and roads would result in long-term direct loss of habitat and indirect alteration of adjacent habitat. The gravel footprints under three hypothetical scenarios range from 476 acres under the low development scenario Alternative B to 2,385 acres under the high development scenario Alternative D (**Appendix B**, **Table B-2**). Direct losses from gravel footprints would last as long as development projects are active, or until gravel is removed from retired roads and pads for restoration. Natural recovery of disturbed sites on the North Slope has been estimated to require 600 to 800 years for upland mesic sites and 100 to 200 years for marsh sites (NRC 2003).

When disturbance occurs to the insulating tundra mat, thermokarst results in permanent alteration of permafrost, vegetation, and surface form. Rehabilitation activities may speed recovery on lightly disturbed sites, but reclamation and restoration of original habitat value has not been achieved for gravel removal in the arctic environment once operations have ceased (see **Sections 3.2.11** and **3.3.1**). It is unlikely that avian habitats could be restored to their original values, although rehabilitated sites may provide adequate breeding habitats for some species (e.g., waterfowl) and foraging habitats for some geese, passerines, and shorebirds (Bentzen et al. 2018).

Potential indirect habitat modification would result from fugitive dust (i.e., dust shadow) and gravel spray, impediments to drainage (impoundments and tundra desiccation), thermokarsting, and delayed melt of snow in snow drifts or berms created by snow removal. Fugitive dust would generally affect the largest area, extending as much as 328 feet from gravel roads (see **Section 3.3.1**; Walker and Everett 1987). Using the range of hypothetical gravel footprints under the low and high development scenarios (476–2,385 acres; **Appendix B, Table B-2**) and applying a multiplier of 8.8 to account for the area within 328 feet (calculated in Coastal Plain Oil and Gas Leasing FEIS, Section 3.3.3 [BLM 2019c]) the area of direct and indirect habitat loss and modification would range from 4,665 to 23,373 acres (**Appendix Q**). The total area potentially affected would depend on the final configuration of roads and pads and the numbers of birds affected would depend on the configuration as well as the location of gravel infrastructure. Under all alternatives, potential loss and alteration of avian habitat from direct effects of gravel deposition and indirect effects of dust, thermokarsting, and impoundments would be long term.

Direct and indirect habitat alteration displaces individuals from locations where they might otherwise nest and feed. Shorebird densities are lower near roads and gravel pads than at distant sites, although there is also evidence that nest densities of some shorebirds are higher in the dust shadows of roads (NRC 2003). Individual shorebirds and passerines whose nest sites were covered by gravel over the winter, have been shown to be displaced to adjacent similar habitats in subsequent nesting seasons (Troy and Carpenter 1990) and greater white-fronted geese appear to respond similarly (Johnson et al. 2003). The impact of displacement on population dynamics is uncertain, but direct and indirect impacts of habitat loss and alteration from gravel placement are not expected to affect population sizes of any bird species.

Potential effects on birds would be ameliorated by minimizing footprints overall (as required by ROP E-5) and by avoiding wetlands specifically, where bird densities are generally highest (Bart et al. 2012), and instead selecting routes and pad sites in uplands and well-drained habitats, including tussock tundra and moist shrub areas. Such habitats are used by nesting landbirds, such as passerines and ptarmigan, and by some species of waterbirds (Bart et al. 2012), however, and impacts on these species could be greater as a result.

Under all alternatives, ROP E-2 prohibits permanent facilities within 500 feet of fish-bearing waterbodies (see exceptions) and K-2 prohibits permanent facilities within 0.25 miles of deep (more than 13 feet deep) waterbodies (see exceptions), further protecting birds using those habitats. See Chapter 2 for detailed description of Stipulations and ROPs. ROP E-11 also protects breeding sites for Steller's and spectacled eiders and yellow-billed loons from disturbance. Where Steller's or spectacled eiders are present in a development area, BLM and USFWS will consult on siting of infrastructure and other mitigation to minimize impacts on the birds and their habitat. Lakes where yellow-billed loons breed will have 1-mile buffers between infrastructure and nest sites and 1,625-foot buffers around nesting lake shorelines.

Barges with supplies would be transported from Dutch Harbor in Unalaska (**Appendix B**, **Map B-2**). One barge transport per year is assumed, but this would depend on the number of large modules needed for central processing facilities and the construction schedule. A barge landing and storage pad would take up about 10 acres, or a gravel island could be constructed for the same purpose. A gravel island could occupy approximately 12 acres. Possible locations for the barge landing would require additional study, but two sites (Atigaru Point and Point Lonely) are proposed for the Willow Master Development Plan (BLM 2018f).

Transport would likely occur during summer and fall, with landings during the open-water season. Screeding for barge access would result in short-term (one season) habitat modification in the affected lagoon prior to each barge arrival. Screeding would modify the sea floor in shallow water, potentially reducing the local abundance of benthic prey. The area of potential recurring screeding and redistribution would depend on the landing location and likely would be lost in the long term to benthic feeding birds. Each screeding event would create a temporary sediment plume that could impede feeding by non-breeding, post-breeding, and staging birds in the plume area, and would likely cause displacement to other feeding areas.

The species most likely to be affected by nearshore barge activity and screeding are post-breeding sea ducks and loons. In nearshore aerial surveys conducted in July and August across the Arctic coast of Alaska, long-tailed ducks were the most abundant species along sections including the NPR-A coastline, followed by eiders, other sea ducks, and small numbers of loons (Fischer and Larned 2004; Lysne et al. 2004). Glaucous gulls outnumbered other species in June, but more sea ducks use coastal waters during post-breeding (Fischer and Larned 2004). King and common eiders were common in shallow and deep waters, whereas spectacled eiders were uncommon (Fischer and Larned 2004); however, Harrison Bay is a concentration area for spectacled and king eiders (Fischer et al. 2002). Scoters were common, and Pacific loons were the most abundant of the three species of loons in surveys. Geese, other ducks, shorebirds, and sea birds were recorded in smaller numbers.

> *All those birds I tell you about, they go all along the coast. After they're born, first two weeks they stay around there, then we see big bunches of babies floating around the lagoon. Inside the lagoon. Hundreds and hundreds of birds. They raise them in the lagoon. All the way up to Icy Cape we always see babies bunched up* (Point Lay) (SRB&A 2011a).

Birds affected by barge traffic would be temporarily displaced, but screeding or module island construction would result in temporary to long-term loss of feeding habitat and displacement; the effects would be site-specific to local and would not be expected to have population-level effects for any species of birds.

Disturbance and Displacement

Disturbance could result in behavioral and physiological responses to human activity or infrastructure and associated visual or sound stimuli during all phases of development. Displacement might result from disturbance, when birds move away from the source of disturbance. Behavior responses include alert and concealment postures and escape, which may or may not be accompanied by increases in heart rate, stress hormones, and energy expenditure. Disturbance and displacement of birds can occur during all seasons, but is more serious for breeding birds that are incubating nests or tending their broods. Disturbance and displacement, from natural (predators and conspecifics) or human activities, affects productivity when it leads to interruptions in normal incubation, temporary displacement from nests, or to nest abandonment, which can result in partial or total predation of clutches of eggs (Johnson et al. 2003, 2008, 2015). It affects survival of young if broods are separated from their parents and fail to reunite. Researcher disturbance also causes birds to leave nests and increases nest failures (Monda et al. 1994; Uher-koch et al. 2015; Meixel and Flint 2017).

> *These wildlife folk that see it—they've witnessed, I guess they are wildlife folks, that walk in the country and [are] looking at birds and things in the Colville River Delta, maybe the east side, down by Uluunniak (ph), that's next to—not far from the old Nuiqsut site, they're monitoring these birds and go to and from these places with a chopper—upsets, disrupts, displaces—perhaps some of [our] only opportunity to go get...game, especially caribou, in the area are scared and may...run off because of these impediments that arrive [and] are not natural. Naturally, [we] would walk along*

> *the coast where they're at and be able to harvest…caribo (Ruth Nukapigak, as cited in BLM 1998, NE NPR-A Scoping, Nuiqsut)* (MMS 2007a; **Appendix Y**).

Noise from humans is almost always associated with other disturbance stimuli, such as traffic, aircraft, machinery, and construction activity. Short duration but very loud sounds can damage birds' ears, although birds (unlike mammals) can regenerate sensory hair cells to some extent (Niemiec et al. 1994). Noise may cause physiological responses, including elevated heartrate, reduced immune response, and decreased reproductive success (Ortega 2012).

Avoidance may be the most common response to noise, although many bird species are tolerant and habituate to many types of disturbance (Ortega 2012). Gas compressor noise was found to have no measurable effects on nest density or reproductive success of longspurs (Gollop et al. 1974a), although human activity, including aircraft, personnel, and vehicle activity, may have affected reproductive success (Gollop et al. 1974c). Studies in New Mexico and Canada found many passerines avoided gas compressor noise (Ortega 2012); however, most species of large waterbirds recorded at a gas compressor plant in Prudhoe Bay were not displaced in relation to noise levels, with the exception of Canada geese during pre-breeding and non-nesting spectacled eiders during the nesting period, which were farther from the plant after its installation (Anderson et al. 1992). Johnson et al. (2003) found no distributional response of nesting greater white-fronted geese to modeled noise levels around an airstrip in the Alpine oilfield. Noise levels attenuate with distance and the effects of noise from stationary facilities on birds are localized (Gollop et al. 1974b; Anderson et al. 1992; Johnson et al. 2003).

Noise and visual disturbance are often coincidental, as they are with road and air traffic. It is rarely possible to separate and identify which causes responses in field studies. At low levels, disturbance could increase the occurrence of concealment postures, interfere with resting and feeding activities, and increase energetic costs. At higher levels, escape behaviors could affect reproduction through increased absences from nests and nest abandonment, thereby increasing the likelihood of predation leading to nest failure (Uher-Koch et al. 2015; Stien et al. 2016) or disintegration of broods and chick predation. Studies of bird reactions to human disturbance in oilfields indicate that responses vary among species, by season and breeding status, by type of human disturbance, and by distance to the source of disturbance (Anderson et al. 1992; Murphy and Anderson 1993; Johnson et al. 2003, 2008).

Waterfowl in areas of high-density oil development in Prudhoe Bay showed no effects of traffic level on displacement (habitat use or distance from roads) for geese and swans (Murphy and Anderson 1993), except brant occurred farther from roads with high traffic levels during construction (but not during operations). Aircraft overflights can temporarily reduce the numbers of waterfowl on lakes (Schweinsburg 1974), but nesting birds show variable reactions. Nesting greater white-fronted geese and tundra swans responded to vehicle and air traffic most often with alert and concealment postures (diminishing with distance from the source), but flushed from aircraft during very close approaches by helicopters, such as during landings (Johnson et al. 2003). Brant were observed to flush from nests in response to some aircraft overflights, while nesting common eiders were rarely observed to show any visible reaction in response to such activities (Gollop et al. 1974a). Flush distances vary by species and species groups (Livezey et al. 2016).

In industrial areas at Prudhoe Bay, routine oilfield activities, such as road traffic, noise, and aircraft flying at the prescribed minimum altitude of 500 feet typically did not cause nesting geese to flush (Murphy and Anderson 1993). Human presence, in contrast, produces a consistently strong disturbance response and people approaching nests typically cause incubating birds to flush and to remain off nests as long as people remained in the vicinity (Gollop et al. 1974a; Murphy and Anderson 1993; Johnson et al. 2003). Although foot traffic on the tundra would be uncommon with most development activities, reduced productivity due to disturbance by foot traffic is the most consistently reported effect of human presence at nesting sites. Researcher visits to nest sites of greater-white fronted geese (Meixel and Flint 2018) and yellow-billed loons (Uher-Koch et al. 2015) reduced nesting success of both species. The indirect effects of such responses to disturbance adversely affect reproduction through increased exposure and loss of eggs and nests to avian and mammalian predators (Johnson et al. 2003; Stien et al. 2016).

Future gravel transport and road, pad, and pipeline construction would take place in winter from ice roads, when few birds would be affected. Afterwards, facility construction would occur from existing gravel roads. Winter activities would occur annually throughout exploration, construction, drilling, and production phases of any development project, but traffic levels and activity would decrease after the construction phase to lower levels during drilling and production. During all project phases, winter activities would cause disturbance, behavioral alterations, and displacement to small numbers of resident wintering birds.

Construction activities during summer would occur on gravel roads and pads, which could cause short-term behavioral changes or displacement of breeding birds in adjacent habitats. Summer construction would involve gravel grading and compacting, module and pipeline hookups, and construction of the camp, operations center, and central processing facilities. Summer construction would have higher levels of machine, heavy equipment, vehicle and air traffic, and more human activity than during drilling or operations, thus higher rates of disturbance-caused behaviors and displacement of birds. During drilling and operations, similar types of disturbance and displacement would continue probably at lower levels. Additional helicopter, boat, and human activity likely would occur throughout the life of any project, associated with pipeline inspection and maintenance, surveying, tundra cleanup (i.e., stick-picking), and spill prevention and response activities on waterways.

> *Now, let's look at what's going to happen after you discover the oil: you're going to have to lay roads, you're going to have to lay gathering systems, you're going to have to lay buildings, you're going to have to lay pipelines. And when you start laying pipelines, then you start harassing animals like spectacled eiders, steller eiders, snow geese, the peregrine falcon, those kind of animals are going to be bothered. When I, as a person, shoot one of those animals I can get fined up to $10,000 and put in jail up to five years. What does the industry get when they damage those animals? What do they get? Nothing. You might give them maybe a $10,000 fine, but heck, that's the price of developing, it's very affordable. But me, that live here, I go to jail...And when you start your development and you endanger those animals that are endangered -- that are on the threatened or endangered species list, when I do it I become a criminal. What are you when you allow it to be done? What is BLM? What is the State of Alaska? When they allow these threatened animals to be endangered you are a criminal too. And it becomes premeditated because you plan it ahead of time* (Utqiaġvik) (BLM 2004c; **Appendix Y**).

To assess potential effects of disturbance and displacement by future road traffic and pad activity, the area within 656 feet of roads, pads, and pipelines was used as a conservative estimate of the area affected by disturbance and displacement for all species of birds. This overestimates the area of disturbance for nesting shorebirds and passerines, which respond at very close distances (43 to 72 feet; Livezey et al. 2016); however, it likely underestimates the area for more sensitive birds, such as nesting tundra swans (at least 1,640 feet or more; Monda et al. 1994). Disturbance and displacement could displace nesting greater white-fronted geese within 0.8 miles of active roads and pads, including an airstrip (Johnson et al. 2003). A review of literature on reported distances from various motorized and nonmotorized human activities, at which nesting birds initially respond and take flight, found all species studied flushed at mean distances of less than or equal to 656 feet, except for falcons, hawks, and eagles, which flushed at greater distances to some disturbance types (Livezey et al. 2016).

Using the same hypothetical gravel footprints from the RFD (**Appendix B, Table B-2**) and applying an additional area within 656 feet to account for the zone of potential disturbance and displacement, the additional area would be estimated by a 15.8 multiplier (calculated in Coastal Plain Oil and Gas Leasing FEIS, Section 3.3.3 [BLM 2019c]). The area of direct habitat loss and disturbance would range from 7,997 to 40,068 acres. The actual area affected would depend entirely on the configuration of roads and pads. Potential impacts of disturbance and displacement by summertime construction and operations would be long term and may affect local nest density or nesting success for some birds near facilities (Liebezeit et al. 2009; Wilson et al. 2013); however, they are unlikely to affect regional population sizes of breeding birds.

Under all alternatives, special efforts are required to avoid disturbance of nesting Steller's and spectacled eiders in the NPR-A. ROP E-11 requires three years of aerial surveys for pre-breeding eiders for projects proposed within the Aerial Waterbird Breeding Population Survey area (Wilson et al. 2018) or the Barrow Triangle Steller's Eider Survey area (Obritschkewitsch and Ritchie 2019) and for one year for projects outside those areas. Results of those surveys and habitat mapping would be evaluated by BLM to determine the need for ground-based nest searches. In the event that Steller's or spectacled eiders are nesting in the proposed project area, the applicant shall work with the USFWS and BLM to site roads and infrastructure in order to minimize impacts on breeding eiders and their preferred habitats. Consultation will consider timing restrictions and other temporary mitigation measures, the location of permanent infrastructure, placement of fill, alteration of eider habitat, aircraft operations, and management of high noise levels. K-2, prohibiting permanent facilities (including roads) within 0.25 mile of deep waterbodies and ROP E-2 prohibiting infrastructure within 500 feet of fish-bearing waterbodies, also would reduce potential for disturbance of birds nesting or feeding eiders in those lakes, ponds, or rivers.

The USFWS, with management authority over threatened and endangered birds, would likely require additional protective terms and conditions as part of its biological opinion authorizing any new development in NPR-A. Indirectly, Stipulations K-1 through K-8, whose requirements vary by alternative (**Chapter 2, Table 2-3**), should reduce disturbance from oil and gas activities to all species in important bird habitats, including rivers, lakes, coastal areas, inlets, lagoons, the Goose Molting Area, and Brant Survey Area (**Appendix A, Map 3-19**).

Future screeding and barging would also cause disturbance to birds in the nearshore zone, including lagoon systems (see discussion of habitat loss and alteration above). These activities could displace and disturb normal behavior of birds in the nearshore marine environment. Both screeding and barging would involve slow-moving vessels (7 knots for barges) and would produce noise and visual disturbance. Boat operations for other activities may also occur. Common eiders and other birds that nest on barrier islands may be disturbed by screeding and barging activities, although common eiders appear to exhibit the fewest reactions to various types of disturbance (Gollop et al. 1974a).

The potential for disturbance and displacement of birds is greatest between early July and late September, when large numbers waterbird species use the nearshore and lagoon waters of the Beaufort Sea (Fischer and Larned 2004) for its shallow water for feeding and protection from wind and waves (Flint et al. 2004). Johnson (1982) reported displacement of long-tailed ducks in response to aircraft, boats, and human disturbance, and Schwemmer et al. (2011) reported ship traffic affected flight reactions in sea ducks and the distribution of loons; however, Flint et al. (2004) found that molting long-tailed ducks using lagoons were not clearly affected by seismic surveys and found little evidence for displacement due to disturbance. In an evaluation of industrial oil and gas activities impacts on nearshore distribution of birds along the central Beaufort Sea coast, no difference was detected in the 10-year trend in density of long-tailed ducks between developed and control areas; densities declined similarly in the two areas and distribution of long-tailed ducks and other species was not related to human activity (Fischer et al. 2002). The authors reported that high variation in survey counts, habitat change, and

Potential behavioral disturbance by screeding and barging vessels and displacement of birds by associated vessel activity would occur annually in a relatively small area and be temporary. Other boating activities may also occur; those would be short term events but they may occur over a broad area and for the duration of a development project or long-term for local subsistence and transportation needs. Additional low levels of disturbance and displacement of waterfowl and seabirds could occur along the marine vessel route between the planning area and Dutch Harbor, Alaska. Periodic disturbance and displacement in nearshore waters of NPR-A or along the pelagic vessel route are not anticipated to result in population-level effects for any bird species.

Air traffic forecasts are provided in **Section 3.4.10**. Effects of air traffic on the acoustic environment are discussed in **Section 3.2.3**. All types of air traffic could disturb and displace both breeding and non-breeding birds. Flight paths will depend on locations of infrastructure but air traffic supporting oil and gas development would include fixed-wing aircraft into Alpine, Deadhorse, Kuparuk, Nuiqsut and Willow (as currently evaluated, BLM 2018a) airports and helicopters to move people and supplies from airports to sites within the planning area. Possibly, additional landing strips will be needed in the planning area. Potential impacts on birds would be widespread and both short- and long-term in duration.

Under all action alternatives, ROP F-3 and F-4 would require flight altitudes above 1,500 feet with 0.5 miles of raptor cliff-nesting sites and minimization of aircraft flights over the Goose Molting Area. Similar altitude restrictions 20 May to 20 August over the Teshekpuk Caribou Habitat Area and Utukok River Uplands Special Area would reduce disturbance of nesting and brood-rearing birds. Use of the Deadhorse airport, where traffic levels already are high and which is the primary hub for the North Slope oil industry, would increase both for passenger and freight flights, increasing potential for disturbance of birds locally and long term, although birds in this area already experience high levels of disturbance.

Under all alternatives, helicopters would be used in the future to support ice road layout; civil surveys; fish, wildlife, and hydrological surveys, summer cleanup, and possibly for spill-response material deployment and maintenance. These activities usually take place in June through August and last approximately 12–14 weeks, with daily helicopter traffic during that time, involving departures from a helipad and landings at various tundra locations.

Helicopter flights would occur during pre-breeding, nesting, brood-rearing and molting, and fall-staging periods for most of the species in the planning area. Helicopter landings on tundra could cause displacement from feeding and loafing areas and from nests, or cause separation of broods, which could allow predators to take eggs or chicks. Helicopter landings and low-level helicopter flights could cause escape movements or flight behavior of individuals or flocks and interfere with feeding and resting; however, such effects are usually very short term and localized.

The intensity of impacts of helicopter flights would vary, depending on number of landings on tundra, landing locations, and seasonal timing. Impacts would occur during all development phases and because their locations cannot be specified, would be geographically extensive.

Noise and air traffic could disturb and displace molting geese that congregate north and east of Teshekpuk Lake in July and August. Simulated gas compressor noise appeared to decrease the numbers of staging snow geese within 3 miles (Gollop and Davis 1974), although some evidence of habituation was observed. Snow geese and brant are easily disturbed by aircraft and other human intrusions during brood-rearing, molting, and staging, making them vulnerable to displacement and potentially significant impacts.

In experimental overflights, flushing distances of staging snow geese on the North Slope have been recorded up to 9 miles from passing aircraft and to overflights at altitudes up to 10,000 feet (Davis and Wisely 1974; Salter and Davis 1974). In these short-term disturbance studies, mean distances of flushing for various types of overflights ranged between 1.0 and 2.5 miles and durations averaged between 5 and 6 minutes, depending on aircraft type and altitude. Frequent disturbance was found to drive geese away from feeding sites (Salter and Davis 1974). Boothroyd (1985) found similar results. Staging brant and Canada geese at Izembek Lagoon reacted with more flight and alert responses to rotary than to fixed-wing aircraft and to aircraft with higher levels of noise (Ward et al. 1999). Reactions to overflights were greater with decreasing lateral distance to aircraft and less correlated with altitudes of aircraft, peaking at mid-altitudes (1,000 to 3,493 feet) above ground level (Ward et al. 1999).

Similar responses to aircraft were recorded in the Teshekpuk Lake area, where large flocks of molting brant were more responsive than small flocks to aircraft overflights and also reacted more strongly to helicopters at mid-altitudes than low or high altitudes; helicopters would have to flyover 3,510 feet above ground level to not cause significant disturbance (Derksen et al. 1992). Primary concerns for disturbance of brood-rearing, molting, and staging geese are decreased feeding time, increased energy expenditure, displacement from feeding areas, which could affect their ability to accumulate adequate energy reserves to fuel their fall migration (Davis and Wiseley 1974) and separation and trampling of young birds from broods.

Under all alternatives, exposure to and disturbance from aircraft would be reduced by Stipulation F3, which restricts altitudes when overflying raptor nests during the nesting and chick rearing periods and the Teshekpuk Caribou Habitat Area during calving and summer season and minimizes flights in the Goose Molting Area (**Appendix A**, **Map 3-19**), during nesting through staging. Indirectly, Stipulations K-4 through K-6, should reduce all forms of disturbance by prohibiting leasing and surface occupancy in coastal areas, inlets, and lagoons, and in the Goose Molting Area; however, the protections conferred by these stipulations are not the same across alternatives; the Teshekpuk Caribou Habitat Area and Goose Molting Area vary in extent among alternatives and aircraft and other restrictions vary among alternatives under the K Stipulations (see **Table 2-3**, **Chapter 2**).

Disturbance and displacement by air traffic will occur during all phases of any future development project. Helicopter support will be an important aspect of exploration and development phases but may be much less important during production. Fixed wing and commercial air traffic may similarly peak during construction but then would level out with regular personnel transportation throughout the production phase; however, with the likelihood that development phases of different projects overlapping, air traffic in general is likely to continue to increase from current levels throughout the time frame of this analysis.

Mortality and Injury

Vehicle and aircraft traffic and tall structures, including communication towers, powerlines, and drill rigs, pose collision hazards that could kill or injure birds. Little information is available on rates of mortality or injury from collisions in the North Slope oilfields. Collisions with vehicles and aircraft would probably be correlated to bird densities and traffic rates and would likely be higher in preferred bird habitats. Vehicle collisions might increase during breeding, when birds are less focused on hazards, and during brood-rearing and molting, when flightless birds may be crossing roads. Siting of roads and tall structures away from coastal migration areas and preferred habitats, could expose fewer birds to collision hazards, and reduced speed limits and driver awareness of seasonal bird vulnerability and congregation areas could reduce collision risk from vehicles.

Collisions with tall structures increase with tower height, bright lighting, and the presence of guy wires (Manville 2005; Gehring et al. 2011). Such structures are particularly hazardous when located in movement corridors or in or adjacent to high-value habitats, such as wetlands (Manville 2005). In the NPR-A, major movements of migratory birds occur along the coast, many associated with the barrier island and lagoon system, but movements also occur onshore and in marine waters. Although facilities in the coastal environment are limited or prohibited (depending on alternative), all alternatives include the possibility of a coastally located seawater treatment plant and docking facilities, both of which could pose hazards to migratory birds. Weather conditions, such as fog, rain, and low light, increase collision mortality of common eiders at towers and transmission lines (MacKinnon and Kennedy 2011). On the North Slope, birds often migrate at low altitudes and in foggy conditions; migrating eiders averaged 40 feet aboveground level at Point Barrow (Day et al. 2004).

Collisions with vehicles, aircraft, or structures in the future would likely injure or kill birds. Although the risk of collisions is low, the consequences are high, resulting in serious injury or death. Unknown numbers of collisions would be expected to occur annually, and mortalities would be a particular concern if flocks of birds of conservation concern are involved. The potential impacts of collisions are long term (they will occur throughout the life of the project) but infrequent and primarily occur in areas with vehicle and air traffic and elevated structures. BMPs requiring records of vehicle and tower strikes would be useful for assessing the magnitude of this impact. Under all alternatives, ROP E-21 would minimize bird collisions by burying or placing utility lines on VSMs (minimizing poles and overhead lines), marking overhead lines for high visibility where they are unavoidable, and designing towers to reduce bird strikes. Under all alternatives, ROP E-10 would reduce collisions of birds with structures by design features to direct exterior lighting down and inward year round.

Construction of oil and gas infrastructure connected to Willow would likely provide access for Nuiqsut subsistence hunters. ROP E-1 protects access to hunting and fishing areas and includes design of roads with pullouts and access ramps for multi-season subsistence use. Increased access would likely increase pressure from subsistence hunters and egg-gatherers. Hunting would increase injury and mortality for adult birds, whereas egging would decrease productivity; both would affect primarily ducks and geese (Naves and Keating 2018). Harvest levels for individual communities are higher than documented mortality from oil and gas activities on the Arctic Coastal Plain.

Oil spills and other releases of contaminants pose well-documented risks of injury or death to birds and their eggs (NRC 1985, 2003). Birds may be killed by oil directly through feather oiling and through ingestion while preening or consumption of contaminated foods, due to both hypothermia and toxicity. In experimental exposures, ducks exposed to low concentrations of Prudhoe Bay crude oil on water transferred contamination to their eggs (Albers 1980) and eggs exposed to even minute quantities of crude or fuel oil had markedly reduced hatchability and increased prevalence of diseased embryos (Albers and Szaro 1978; Szaro et al. 1978; Couillard and Leighton 1991). In additional to direct mortality (Piatt et al. 1990), spills can have long-term toxicological effects with direct and indirect effects on avian reproduction and habitat use (Szaro 1977; Wells et al. 1995). Spills also affect birds indirectly, through changes in habitat and food supply and by exposure to contaminants through the food chain.

During seismic exploration, the primary potential for release of contaminants would be accidental fuel spills from vehicles, storage tanks, aircraft, and equipment during transport or refueling and such spills would be medium to small (see **Section 3.2.12**). Such spills would continue to be the most common types of spills throughout any future development project and most small spills would involve refined oils and fuel, antifreeze, or saltwater used in hydro-testing and well injection. Crude oil spills would not be a risk until drilling and operation, when there is greater risk of large or very large spills (see **Section 3.2.12**), due to well blowout or pipeline failure.

Project development activities would include construction in or next to the shoreline for both seawater treatment plant and barge landings, as well as annual barge traffic (one barge transports per year are anticipated), increasing the risk of small to large fuel spills in the nearshore marine environment and on the shipping route. The rate of occurrence of spills will increase with levels of human activity, including both traffic levels and volume of crude oil production, and with the age of any particular development.

Although the risk of spills is reduced in the various areas with no leasing, NSO, and prohibitions to permanent infrastructure designated under each alternative, the frequency of occurrence of spills would not differ. Setbacks from lakes under all alternatives (ROP E-2), prohibition of exploration drilling on rivers and lakes (Stipulation K-3), and setbacks or restrictions varying by alternative (K-1, K-2, K-4, K-5, K-6,and K-7), would provide some protection from accidental fuel spills for important avian habitats, although all alternatives include exceptions for essential pipelines, roads, and gravel mines.

Spills in water would be more difficult to contain, but important coastal and lagoon habitats and molting areas for migratory birds are closed to leasing or have NSO under most alternatives (Stipulation K-4 to K-7, but see exceptions under Alternative D for K-6 and K-7), with exceptions for barge landings and essential pipelines and coastal infrastructure), somewhat reducing the potential area for that small or medium spills could affect in coastal and aquatic areas.

Under all alternatives, ROPs A-1 and A-2 would minimize generation and hazards of solid and hazardous wastes and ROP A-4 and A-5 would provide protection from some types of fuel spills for avian habitats associated with waterbodies, marshes, and in riparian areas (fueling equipment and fuel storage over 210 gallons would be prohibited within 100 feet of the active floodplain of any waterbody, see exceptions). ROP E-2 and Stipulations K-1 and K-2 would reduce the likelihood of fuel or other spilled materials in fish-bearing waterbodies, streams, and deep lakes which are important to some species of birds.

Small spills are likely, medium-sized spills are less common, and large and very large spills are uncommon (see **Section 3.2.12**). Most spills would be fewer than 100 gallons and would be restricted to ice or gravel roads and pads, never reaching the tundra and having no impacts on birds. Spills that reach tundra are less common and typically affect less than 5 acres (BLM and MMS 1998), but could affect small numbers of nesting or foraging birds, depending on location and timing. Habitats affected by such spills are subject to short-term or long-term alteration, depending on the type of spill and rehabilitation efforts.

Although large and very large spills are uncommon, they do occur (three larger than 100,000 gallons have occurred on the North Slope, see **Section 3.2.12**) and such spills could pose substantial risks to migratory birds and their habitats, depending again on location and timing. Large spills may have cleanup activities lasting days to weeks, and could pose contamination risk to large numbers of molting, feeding, or migrating birds (see NOAA 2002). Large spills from blowouts or from pipeline leaks could reach rivers and streams and the nearshore lagoon system. Spill containment at strategic points on waterways would likely keep oil from flowing downstream into lagoons. Nonetheless, if oil escaped, many species would be vulnerable.

> *I have gone how many times to Inigok where there was some drilling that took place, and I have seen bones from birds that have been killed from the, from after they drill a hole, the stuff they leave behind, the fluids. I don't want to see that kind of thing happening where we see our wildlife and waterfowl dying from contaminants being left after having conducted drilling activity, I don't want to see that kind of thing. And leaving an area without having done some kind of thing to put it back into the shape it was before the drilling took place* (Atqasuk) (SRB&A 2003).

Fuel spills in the marine environment may affect birds during construction and operations of docking facilities, gravel islands, seawater treatment plants on the coast, shipping activities, and during screeding for barge landings. Most fuel spills would be medium to small, would occur during open water seasons in mid to late summer, and would be localized, assuming rapid response and containment.

Barge traffic also increases the risk of fuel spills along the marine transport route. Eiders migrating along the Beaufort and Chukchi Sea coasts may be particularly vulnerable to spilled oil that reaches the marine environment. Spills along the marine transport route along the west coast of Alaska could affect critical habitat for Steller's and spectacled eiders. Medium to very large spills in the ocean would be possible if a vessel ran aground and fuel tanks were breached. This could occur in the shipping lanes or nearshore waters between NPR-A and Dutch Harbor. The M/V *Kuroshima* ran aground on Unalaska Island in 1997 spilling oil that killed many hundreds of birds, and cleanup activities extended through summer 1999 (NOAA 2002).

Attraction to Human Activities and Facilities

Both birds and mammals may be attracted to human activities. Future oil development projects in the program area would likely increase the numbers of scavengers and predators in the area, beginning in the construction phase and continuing through operations. Effective food and garbage control, wildlife interaction plans, and personnel training (see ROPs A-1, A-2, and A-8) should minimize the attraction of predators to oilfield facilities; however, the potential for development to attract scavengers and predators would still be a concern because increased predator abundance can decrease productivity and increase mortality of nesting birds (Truett et al. 1997; Johnson et al. 2003; Liebezeit et al. 2009).

> *I do have a few other wildlife issues and concerns and these mostly have to do with birds. The first is oilfield activity or the development of oilfields on the North Slope has most likely increased -- well certainly has increased some predator populations and has mostly likely led to the increase of other predator populations. And the predators I'm speaking of are foxes, ravens, and gulls. Part of the issue is garbage and that garbage has allowed -- has provided additional food sources for these predators. There's another issue that's out there, though, too, and that concerns mostly ravens, but foxes as well, and that's -- there are places where ravens can now build nests or foxes can den or take their young. And so those are some of the reasons that the predator populations have increased as well. The result of those increased predator populations has been a*

> *decrease in the productivity of many birds that nest within the oilfields and many of those birds are important for subsistence* (Utqiaġvik) (BLM 2003a).

On the North Slope, ravens and, to a lesser degree, peregrine falcons, gyrfalcons, and rough-legged hawks nest and perch on human-made structures, including buildings, elevated pipelines, bridges, towers, drill rigs, and wellheads (Ritchie 1991; Frost et al. 2007; Powell and Backensto 2009). Some species of songbirds (e.g., snow buntings, common redpolls) also are attracted to human structures for nest sites. For these few avian predators and passerines, infrastructure may increase the occurrence of breeding sites on the NPR-A and the effects would be widespread and long term.

Two avian predators, glaucous gulls and common ravens, are attracted to human food (Day 1998; NRC 2003), and populations of these species have increased on the coastal plain of the North Slope (Stehn et al. 2013). Foxes and bears also prey on birds and their eggs and are attracted to areas of human activity, where they readily feed on garbage and handouts (Eberhardt et al. 1982; Follmann and Hechtel 1990; Savory et al. 2014 see also **Section 3.3.6**). Arctic foxes in oil-development areas occur at higher densities and experience reduced population fluctuations, compared to foxes in undeveloped regions, increasing potential levels of predation of nesting birds and their eggs (Eberhardt et al. 1983; Burgess 2000). Foxes also use human structures (gravel berms and empty pipes) for denning and shelter (Eberhardt et al. 1983; Burgess et al. 1993). Future development projects would attract foxes throughout the year and grizzly bears in summer and fall. Impacts on nesting birds would include long-term reduction in nesting success, some adult mortality, and effects would be widespread. Liebezeit et al. (2009) detected reduced nest survival among Lapland longspurs from predation up to 3.1 miles from oilfield infrastructure, although no similar effect was detected for shorebirds. Increased predation may be an important factor limiting abundance of some bird species.

Marine Shipping

Future barging and in-field transport of central processing facilities and other modules would occur early in the construction phase of any development project and could also directly affect birds through habitat loss and disturbance. Screeding might be required for barge landing sites, which would cause short-term disturbance and displacement and long-term loss of benthic habitat over a small area. The area of potential screeding and redistribution would likely be lost in the long term to benthic feeding birds and would create a sediment plume that could disrupt feeding by non-breeding, post-breeding, and staging birds in the short term. Although high numbers of birds use the lagoons where barge landings would likely occur, they are highly mobile and likely would be able to move to adjacent similar areas if necessary. A hypothetical barge route from Dutch Harbor to the Beaufort Sea coast is shown in **Appendix A**, **Map 3-23**. Both screeding and barging would involve slow-moving vessels (7 knots for barges) and would produce noise and visual disturbance. Boat operations for other activities may also occur.

Climate Change

The effects of climate change described in the *Affected Environment* above, could influence the rate or degree of the potential direct and indirect impacts from management actions through changes in habitat composition and availability and through changes in avian species distribution, abundance, productivity, and adaptation to environmental conditions. Because of the complex interactions of climate change effects, there is even greater uncertainty on how climate change will interact with direct and indirect effects of land management allocations in the NPR-A.

The effects of climate change described under the *Affected Environment*, above, are part of the baseline conditions for birds in the project area. See **Section 3.2.1** for a detailed discussion of the alternatives' contributions to global climate change.

Impact Analysis Methods

For most actions in the planning area, potential impacts can be described only qualitatively, either because resource and impact data are unavailable or because project-specific details are uncertain or unknown at the time of this analysis; however, for some management options that are applied to general areas, estimates of numbers of birds that could be affected by the management regimes under the alternatives can be estimated. Absent specific project descriptions, the BLM assumes that any potential project could affect different numbers and species of birds depending on the alternative selected, because the alternatives determine the locations and acreages available for the various management allocations (for example, open or closed to oil and gas leasing, open or closed to surface occupancy, open or closed to permanent infrastructure) (see **Maps 2-1**, **2-2**, **2-3**, and **2-4**, **Fluid Mineral Leasing**). Implied is the assumption that all projects could occur throughout areas available to development with equal probability.

To further refine the probability of project locations, the areas of high, medium, and low development potential are applied (**Appendix B**, **Map B-1**). The BLM used breeding bird distributions from 25 years (1992–2016) of aerial surveys conducted by the USFWS (Wilson et al. 2018), and reanalyzed into average annual density distributions in 36 square kilometers (km^2) grids (Amundson et al. 2019) and other species specific data as spatially explicit maps of bird distribution, which are intersected by boundaries of management allocations from each alternative and by development potential. For each alternative, the BLM calculated estimated numbers of birds (from density multiplied by acres for each grid cell, and in some cases nests, colonies, or broods) in each management allocation under each alternative that could be subject to potential direct and indirect effects of oil and gas leasing (or permanent infrastructure) across all the area identified as having the highest development potential. These estimates form the basis of the alternative comparisons in this analysis. Estimates of numbers of birds directly or indirectly affected are not possible because those would depend on the location, size, and description of specific projects, which are not reasonably foreseeable at this time.

Impacts Common to all Action Alternatives

All action alternatives allow for construction of community infrastructure with appropriate mitigation. Community infrastructure could include roads, powerlines, pipelines, and communication towers, owned or maintained by local governments, tribes, or ANSCA corporations. The impacts on birds of each type of infrastructure are described above. The construction and use of a community road north of Teshekpuk Lake is not related to oil and gas leasing but would have similar potential direct and indirect effects as roads supporting oil and gas development, but with the additional risk of losses to subsistence hunting. Effects would include loss and modification of habitat from ice and gravel deposition and gravel and dust spray, disturbance and displacement from traffic, and injury and mortality from collisions, spills, and increased subsistence harvest activity due to increased access. Cell and other communication towers, to increase safety, would add to bird collision risk.

The location of the road has not been specified, but its placement north of Teshekpuk Lake would place it in an area long identified for its importance to breeding, brood-rearing, and molting waterfowl (**Appendix A**, **Map 3-18**), particularly molting geese (**Appendix A**, **Map 3-19**), as well as shorebirds, landbirds, seabirds, and loons. No traffic estimates are available, but this will be the first road connection between Utqiaġvik and Nuiqsut, which could generate frequent traffic from both locations. Given the number of waterfowl and caribou using these areas, the subsistence harvest pressure could be substantial, increasing mortality to adult birds and loss of eggs to harvesting, particularly for geese and ducks. See description in **Section 3.4.3**.

Alternative A

Alternative A is the current management regime authorized under the last ROD (BLM 2013). The ROD established lease stipulations and BMPs, many of them very similar to the stipulations and ROPs, respectively, which are proposed for the other alternatives. Alternative A maintains the five special areas (**Map 2-18 Appendix A**), four of which have particular relevance to birds: Kasegaluk Lagoon and Peard Bay (primarily for sea ducks, sea birds, and marine mammals), Teshekpuk Lake Special Area (primarily for caribou and brood-rearing and molting geese, but many other species as well), and the Colville River Special Area (primarily for nesting peregrine falcons and other raptors). Under Alternative A, in the high development potential area (the eastern portion of NPR-A, **Map B-1**, **Appendix B**), the second smallest area is available for oil and gas leasing under standard terms and conditions(1,154,000 acres) and the second lowest number of acres subject to surface disturbance (1,375 acres) among the four alternatives (**Tables B-1** and **B-2**, **Appendix B**).

The most abundant birds estimated from average annual densities in the high development potential area where oil and gas leasing would be allowed subject to standard terms and conditions were greater white-fronted geese (3,881 birds) and Pacific loons (2,788 birds; **Appendix Q**). Those numbers represented about 7 percent of the greater white-fronted geese in the total area surveyed within NPR-A and 11 percent of the Pacific loons in the same survey area (**Map 3-12**, **Appendix A**). The least abundant birds were snow geese (18 birds, 2 percent of the birds in the surveyed area in NPR-A) and Steller's eiders (13 birds, 5 percent of the NPR-A total). Among the alternatives, Alternative A could potentially indirectly impact the second lowest number of birds (for all ten species of birds evaluated) in the area potentially subject to oil and gas leasing in the high development potential area. For the medium development potential area (the central portion of NPR-A, **Map B-1**, **Appendix B**), Alternative A was mid-range in numbers of birds that potentially would be indirectly affected (**Appendix Q**). In the low development potential area (the western portion of the NPR-A, **Map B-1**, **Appendix B**), numbers of birds indirectly affected were similar among alternatives, but low (particularly for geese and Steller's eiders). The exception was spectacled eiders with over 20 percent of the NPR-A total potentially affected in all alternatives.

The numbers of birds in the area of high development potential within areas available to placement of permanent infrastructure under Alternative A (includes areas available for infrastructure, available to pipeline corridors, unavailable except for essential pipelines, unavailable except for essential roads and pipelines, and unavailable except for essential coastal infrastructure) were mid-range among the alternatives (**Appendix Q**). The most abundant birds were greater white-fronted geese (9,288 birds, 17 percent of the birds in NPR-A) and Pacific loons (4,612 birds, 18 percent of the birds in NPR-A). The medium development potential area contained higher numbers of most species— greater white-fronted geese, brant, three species of eiders, and three species of loons —compared with the other two development potential areas across all alternatives (**Appendix Q**). The low development potential area contained numbers of birds that were remarkably similar among alternatives; that is, no alternative in the low development potential area would expose more birds than other alternatives to direct and indirect effects of infrastructure construction.

Alternative A maintains the Colville River Special Area, intended to provide extra protection for the arctic peregrine falcon and other raptors nesting along the cliffs and bluffs of the river. BMP F-1 requires aircraft maintain 1,500 feet altitude when within 0.5 miles of identified nesting sites during 15 April to 15 August for all raptor nests and 15 March to 15 August for gyrfalcon nest sites. The Colville River Special Area conveys no specific protections to nesting raptors beyond those listed in the BMP. All other alternatives eliminate the Colville River Special Area but maintain ROP F-3, which confers equal protections to those in BMP F-1.

Alternative B

Among all alternatives, Alternative B in the area of high development potential has the smallest area allocated to oil and gas leasing and standard terms and conditions (1,094,000 acres) and the smallest area of surface disturbance (1,236 acres) (**Tables B-1** and **B-2**, **Appendix B**). Likewise, the lowest number of birds of all species evaluated occur in the areas open to leasing (**Appendix Q**) in the areas of high and medium development potential under Alternative B and thus the lowest numbers most likely to be affected directly and indirectly by future developments. As mentioned above, the Alternatives were similar in numbers of birds in the areas open to oil and gas leasing in the low development potential area. The number of greater white-fronted geese in areas open to oil and gas leasing in the high development potential area was estimated to be 2,423 birds or 4 percent of the total in NPR-A. The number of Pacific loons in those areas was estimated to be 2,123 birds or 8 percent of the total in NPR-A.

Under Alternative B, the numbers of birds of all species evaluated were also the lowest in areas available for permanent infrastructure among the four alternatives in the high development potential area (**Appendix Q**). Greater white-fronted geese (4,882 birds, 9 percent of the NPR-A total) were about half the number under Alternative A. Fewer Pacific loons also were in areas available for infrastructure under Alternative B (3,204 birds, 13 percent of the NPR-A total) than under Alternative A. The relationship for the number of birds among alternatives in the medium development potential area was the same as in the high development potential area; that is, Alternative B would have the potential to affect directly and indirectly the fewest birds of all the alternatives. In the low development potential area, the numbers of birds in areas available to infrastructure construction were similar among alternatives

Alternative C

Alternative C has larger areas potentially open to oil and gas leasing and permanent infrastructure than Alternative A. In the high development potential area, 1,394,000 acres would be open to oil and gas leasing and surface occupancy and possibly 1,736 acres would be subject to surface disturbance (**Tables B-1** and **B-2**, **Appendix B**). As a result, more birds are in the high development potential area under Alternative C than under Alternative A, but for most species the difference is small (**Appendix Q**). Alternative C would open areas containing 5,125 greater white-fronted geese (9 percent of those in the NPR-A survey area) to oil and gas leasing and 3,084 Pacific loons (12 percent of those in the NPR-A survey area; **Appendix Q**). In the medium development potential area, Alternative C would expose fewer birds of some species to potential oil and gas impacts than under Alternative A, but for other species more birds would be exposed. For example, 472 yellow-billed loons are in areas open to leasing under Alternative C, compared with 350 under Alternative A. Alternative C would potentially impact the similar numbers of birds as would Alternative A for most species evaluated with the notable exception of yellow-billed loons.

In areas available for infrastructure construction in the high development potential area under Alternative C, species abundances were similar to those under Alternative A (**Appendix Q**). About 400 additional greater white-fronted geese (9,674, 18 percent of the NPR-A total) would be in areas where permanent infrastructure could be approved under Alternative C than under Alternative A (**Appendix Q**). About 100 more Pacific loons (19 percent of the NPR-A total) under Alternative C could be in areas available to infrastructure than under Alternative A. Virtually the same number of eiders (including Steller's and spectacled eiders) and loons (including red-throated and yellow billed loons) were in areas available for infrastructure placement under Alternative C as under Alternative A. The numbers of birds of all species were also similar between Alternative C and Alternative A in the in the medium and low development potential areas (**Appendix Q**), thus any direct and indirect effects on birds of potential infrastructure construction would be roughly equivalent between these two alternatives.

Alternative D

Alternative D contains the largest areas open to oil and gas leasing and infrastructure. Approximately 1,409,000 acres would be open to oil and gas leasing under standard terms and conditions and as much as 2,385 acres could be subject to surface disturbance in the high development potential area (**Tables B-1** and **B-2**, **Appendix B**). More birds of all species occur in the areas open to leasing under Alternative D than all the other alternatives. Almost three times as many greater white-fronted geese (9,779, 18 percent of the number in NPR-A) occur in areas open to oil and gas leasing under Alternative D as under Alternative A (**Appendix P**). Slightly less than twice as many Pacific loons (4,459, 18 percent) are in the areas open to leasing as are in Alternative A. Alternative D, in both the medium and high development potential areas has the highest numbers of birds of all species evaluated in areas open to leasing and some level of surface occupancy, ranging from 10–41 percent of species numbers in the area surveyed in NPR-A.

The largest percentages of spectacled and Steller's eiders in NPR-A (30 percent and 37 percent, respectively), among all alternatives were in areas open to leasing under Alternative D in the medium development potential area (**Appendix P**). Likewise, the largest percentages (29–41 percent of those in NPR-A) of all three species of loons were in areas open to leasing and the medium development potential under Alternative D. Only in the low development potential area were numbers of birds under Alternative D similar to Alternative A and the other action alternatives.

Consistent with the assessment of oil and gas leasing for Alternative D in the high development potential area, more birds of the species evaluated occur in areas available for infrastructure under Alternative D than in other alternatives (**Appendix Q**). About 5,000 more greater white-fronted geese (26 percent of birds in NPR-A) were in areas open to infrastructure under Alternative D than Alternative A. Almost 1,000 more Pacific loons (23 percent of those in NPR-A) were in areas available to infrastructure under Alternative D than Alternative A. The percentage of birds in the surveyed portion of NPR-A that are in the areas open to infrastructure development under Alternative D ranged from 15 to 59 percent in the medium and high development potential areas, with numbers of all species in both areas highest under Alternative D (**Appendix Q**). Only in the low development potential area would Alternative D affect similar numbers of bird as the other alternatives. Alternative D would have the potential to affect the highest proportion and number of birds directly and indirectly from both oil and gas leasing and permanent infrastructure construction if development projects were authorized.

Cumulative Impacts

The geographic scope of the analysis of cumulative impacts includes the NPR-A, the Arctic Coastal Plain, and the nearshore marine waters of the Arctic Coastal Plain. The majority of birds breeding in NPR-A are migratory, connecting global regions where different species migrate to and from wintering grounds. Impacts to widespread and diverse wintering grounds from activities on breeding grounds in the NPR-A are possible, but most species are more at risk from habitat changes and degradation in wintering areas, which are recognized to be driving population declines in many vulnerable species (see Audubon 2017).

The time frame of the analysis extends generally from the 1970s through 2090, approximately 70 years after issuance of the ROD. The impacts on birds described above for the four alternatives would be similar or identical to those from past, present, and reasonably foreseeable oil and gas developments, non-oil and gas developments, and local community changes.

The cumulative effect of past, present, and reasonably foreseeable impacts would increase the occurrence, extent, intensity, and duration of these common impacts. Those impacts will likely grow incrementally in the future as infrastructure extends westward from the Alpine Satellites (including CD-5, GMT-1/MT-6, GMT-2/MT-7 and Willow), inland from the coast if oil and gas is developed offshore (for example, in Smith Bay), and eastward from Utqiaġvik if a community road is constructed north of Teshekpuk Lake to connect with Nuiqsut. Developments for oil and gas extraction in NPR-A are likely in both terrestrial and marine areas, as have occurred with previous projects in the Prudhoe and Kuparuk regions, with barging, docking, and potentially construction of offshore drilling islands and pipelines; impacts on birds would occur in both environments. New development would potentially have greater negative effects and potentially increased cumulative impacts if development occurred in areas of concentrated bird use, such as lagoons, river deltas, and coastal salt marshes. The high density goose molting areas and coastlines, which are concentration areas for breeding, molting, brood-rearing, and staging geese, other waterbirds, and shorebirds would be most sensitive to all phases of oil and gas development.

The National Research Council (NRC 2003) identified higher predator densities and increased predation on nests as the most apparent and common effect of oil development on birds. Transportation activities are anticipated to increase in support of oil and gas development projects, other potential commercial projects, and northern villages, along with increases in research, subsistence, and recreational transportation. Increased transportation would include on- and off-road vehicle traffic, marine barge and boat traffic, and air passenger and cargo traffic.

Future vehicle, boat, and air traffic would result in increasing levels of disturbance of birds as well as habitat modification and displacement. Subsistence activities involving hunting and egg harvesting would likely expand to areas with new roads, as it has with the CD-5, Nuiqsut Spur, and GMT roads, and may possibly increase boat traffic along the coast and rivers. If residents of adjacent villages are allowed access to roads, overall harvest of birds and eggs is likely to increase. Future subsistence activities and scientific research by themselves are generally localized, seasonal, and therefore unlikely to have major negative impacts on bird populations, but they would incrementally increase the extent and magnitude of disturbance, displacement, and mortality, which could add to negative cumulative effects of oil and gas development in local areas.

Recreation and tourism could negatively affect birds, depending on locations and seasons, intensity, and types of transport. Air-based sightseeing could cause widespread disturbance, as could cruise ships attempting the Northwest Passage. Community development projects, such as airport improvements, gravel mines, roads and ports, telecommunication, and energy projects, all would affect local birds in the vicinity of such communities but would result in small increases in impacts on bird populations. The effects of climate change described under *Affected Environment* above, could influence the rate or degree of the potential cumulative impacts. Although the types of impacts would be similar for all alternatives, Alternative D has the potential for the most extensive oil and gas leasing and infrastructure, and if development occurred, would also have the potential to increase the overall cumulative impacts more than the other alternatives being considered.

3.3.5 Terrestrial Mammals

Affected Environment

A total of 31 species of terrestrial mammals are known or thought to occur in the NPR-A (**Appendix R, Table R-1**; BLM 2012 Table 3-19; MacDonald and Cook 2019), including 11 species that are near the northern edge of their range and may be only rare or accidental in the NPR-A. The NPR-A is primarily in Alaska Department of Fish and Game, Game Management Unit 26A, and covers most of that unit. Previous references with detailed species and life history accounts of terrestrial mammal species are incorporated by reference and summarized below (BLM and MMS 1998, 2003, BLM 2012 Section 3.3.6).

Special Status Species

No terrestrial mammals in the NPR-A are listed as threatened or endangered or on the BLM list of sensitive species (BLM 2019), although the Alaska hare (*Lepus othus*) is on the watchlist and may have previously occupied the NPR-A (MacDonald and Cook 2009, Cason et al. 2016). A recent reanalysis of records of Alaska hare only found one verified specimen from the North Slope collected in 1898, although there was also a sighting 190 km northeast of Kotzebue in 1978 (Cason et al. 2016). Although the current range does not appear to include the Arctic Coastal Plain, it is possible that a northward expanse into the area could occur due to climate change as suitable habitat becomes less available to the south (Leach et al. 2015, Cason et al. 2016). The Holarctic least shrew (*Sorex minutissimus*; formerly classified as the Alaska tiny shrew [Hope et al. 2010; Bradley et al. 2014]) was previously listed as a sensitive species (BLM 2010) due to limited information, but it appears to be widespread but scarce across Alaska. Only one specimen of Holarctic least shrew has been collected on the North Slope, in the northern foothills of the Brooks Range east of the NPR-A, but specimens have been collected in Cape Krusenstern National Monument and Kobuk Valley National Park (Cook and MacDonald 2004).

Caribou

Caribou are the most abundant large terrestrial mammal in the area and an important species for subsistence hunting, non-local hunting, and wildlife viewing. Caribou herds in Alaska are defined by the geographic location of their calving areas (Skoog 1968). There are four Arctic Alaska caribou herds: the Western Arctic Herd, Teshekpuk Caribou Herd, the Central Arctic Herd, and the Porcupine Caribou Herd. A large proportion of the Western Arctic Herd and Teshekpuk Caribou Herd ranges are in the NPR-A, the Central Arctic Herd generally remains east of the Colville River but sometimes uses the northeastern NPR-A, especially during late summer (Prichard et al. 2019a). The Porcupine Caribou Herd does not use the NPR-A (Russell et al. 1993, Caikoski 2015) and is not discussed further.

Life History

Caribou have a low energetic cost of locomotion (Fancy and White 1987) which allows them to travel long distances in order to balance seasonal tradeoffs between maximizing forage quality, quantity and availability; while minimizing predation risk and exposure to insect harassment. Each of the Arctic Alaska herds uses a somewhat different strategy. The probability of calving is related to fall body condition (Cameron and Ver Hoef 1994, Cameron et al. 2000), therefore reproduction and overwinter survival for caribou cows are dependent on the amount of protein and fat reserves acquired during the summer and fall. Caribou forage selectively which has a multiplier effect on productivity (White 1983).

Caribou diets shift throughout the year based on the availability of forage within different seasonal ranges. Buds of tussock cotton grass (*Eriophorum vaginatum)* appear to be very important early in the calving season, with *orthophyll* shrubs (especially willows) predominant forage during the post-calving period (Thompson and McCourt 1981) although the Teshekpuk Caribou Herd summer diet is dominated by sedges

(Parrett 2007). The use of the Arctic Coastal Plain during summer may extend the period when caribou can find forage with adequate digestible nitrogen (Barboza et al. 2018). The winter diet of caribou consists predominantly of lichens. The winter diet of Western Arctic Herd animals was comprised of 71 percent lichen, 11 percent moss, and 9 percent shrubs (Joly and Cameron 2018b). Parrett (2007) found that the diet of Teshekpuk Caribou Herd animals wintering on the Arctic Coastal Plain was dominated by lichens and mosses during late spring.

Most adult female caribou (>2 years-old) give birth to a single calf in late May or early June. Caribou calving grounds are located in areas where high quality, newly-emergent forage that is highly digestible and high in nitrogen is available to lactating females (Kuropat 1984; Johnstone et al. 2002). Northern Alaska calving areas are also in areas with low predator densities and access to insect relief habitat. Cows and calves begin to form large nursery bands during the post-calving period (Murphy and Lawhead 2000), but once mosquitoes (*Aedes spp.*) emerge, typically in late June, caribou form large aggregations and move to mosquito relief habitat (White et al. 1975, Yokel et al. 2011). The Western Arctic Herd uses ridgetops in the Brooks Range for mosquito relief while the Teshekpuk Caribou Herd and Central Arctic Herd move to coastal areas (Dau 2015, Prichard et al. 2019a). By mid-July, both mosquitoes and oestrid flies (warble fly, *Hypoderma tarandi*; nose-bot fly, *Cephenemyia trompe*) are active and caribou on the Arctic Coastal Plain move more rapidly than at any other time of year (Fancy et al. 1989, Prichard et al. 2014). In response to fly harassment, large caribou herds break up and disperse widely to seek fly relief in unvegetated habitats, such as river bars, dunes, drained-lake basins, pingos, ridgetops, and when in areas of industrial development, on gravel roads and pads or under buildings (White et al. 1975; Pollard et al. 1996; Murphy and Lawhead 2000). Hot summers with severe insect harassment can cause caribou to enter the winter in poor condition (Colman et al. 2003; Weladji et al. 2003; Couturier et al. 2009).

Fall migration coincides with the breeding season (rut) in October, a period when male caribou have been estimated to lose 23 percent of body protein and 78 percent of body fat (Barboza et al. 2004). During winter, wind and snow conditions (snow depth and density) greatly influence the availability of winter forage (Bergerud 1974) and deep snow can reduce population growth (Solberg et al. 2001), calf birth mass (Adams 2005), and birth rate (Ferguson and Mahoney 1991). Distribution of preferred winter forage (particularly lichens), weather conditions, and predation pressure affect winter distribution and movements (Roby 1980, Joly et al. 2010, Bieniek et al. 2018).

Western Arctic Herd

Population Status—In the early 1970s, the Western Arctic Herd population was estimated at 243,000 animals, but declined to 75,000 animals by 1976. The herd then grew to a recent peak of 490,000 caribou in 2003 (Dau 2015). The herd declined to 201,000 in 2016 before increasing to 259,000 in the most recent estimate in 2017 (Hansen 2018).

Distribution and Movements—The Western Arctic Herd ranges over much of northwestern Alaska. The use of the Utukok Uplands for calving by the Western Arctic Herd has been documented since the 1960s (Dau 2007, 2015) and reported as early as the early 1900s (Davis and Valkenburg 1978). However, there is some inter-annual variation (described in BLM 2012 Section 3.3.6.1) with calving typically occurring farther south in years of late snowmelt (Dau 2007).

The Western Arctic Herd exhibits a consistent pattern of movement across the Brooks Range during the summer (Dau 2015). After calving, caribou begin to move west onto the Lisburne Peninsula west of the NPR-A. In early July, mosquito harassment causes most of the herd to form into large aggregations, sometimes numbering greater than 200,000 individuals, and move rapidly east through the Brooks Range.

As insects diminish in early to mid-August, the caribou disperse. Some move further west and north onto the North Slope, while others remain in the foothills and Brooks Range Mountains.

The fall migration begins as early as mid-August for some Western Arctic Herd animals and extends until late November (Joly and Cameron 2018a). The winter range of the Western Arctic Herd has changed over time and varies annually. Before the mid-1970s, a substantial portion of the Western Arctic Herd wintered north of the Brooks Range, including in the NPR-A, or near Wiseman and Anaktuvuk Pass (BLM 2012 Section 3.3.6.1). Since the mid-1970s, the primary winter range of the Western Arctic Herd in most years has been south of the Brooks Range along the northern fringe of the boreal forest (Dau 2015) with extensive use of the northeastern Seward Peninsula in recent years (Joly and Cameron 2018a).

Teshekpuk Herd

Population Status—The Teshekpuk Caribou Herd increased substantially in size from the mid-1970s when it was first recognized as a separate herd (Davis and Valkenburg 1978) and thought to be 3,000 to 4,000 caribou until it reached its peak estimated population size of 68,932 animals in July 2008 (Parrett 2015). The herd subsequently declined to an estimate of 39,172 animals in 2013. The herd was then estimated at 41,542 animals in 2015 and 56,255 in 2017 (Klimstra 2018) indicating the population had stabilized and was increasing.

Distribution and Movements —The Teshekpuk Caribou Herd typically calves near Teshekpuk Lake or in areas to the west of the lake (Kelleyhouse 2001, Person et al. 2007, Wilson et al. 2012, Prichard et al. 2019a*). Caribou were reported to calve south and west of the lake before 1978 (Davis and Valkenburg 1978*), but telemetry data from 1990–present suggest calving is now concentrated southeast and northeast of Teshekpuk Lake (Person et al. 2007, Parrett 2015, Prichard et al. 2019a). Wilson et al. (2012) analyzed factors affecting seasonal Teshekpuk Caribou Herd distribution at two spatial scales and mapped the best quality calving area based on the attributes of used areas, although significant calving occurred west of the lake, especially after 2010 (Parrett et al. 2015) including in areas west of Atqasuk (Prichard et al. in press).

After calving, the Teshekpuk Caribou Herd uses the area north of Teshekpuk Lake as the primary mosquito relief habitat with animals repeatedly traveling through the narrow corridors on either side of the lake (Yokel et al. 2011). After the mosquito harassment period, the Teshekpuk Caribou Herd spreads out and can be found across the North Slope coastal plain, primarily within the NPR-A (Wilson et al. 2012). Most Teshekpuk Caribou Herd caribou winter on the Arctic Coastal Plain but a substantial portion of the herd, including a disproportionate number of bulls, winter in the central or western Brooks Range (Person et al. 2007, Parrett 2015). In the winter of 2003–2004, a large portion of the Teshekpuk Caribou Herd wintered in the eastern Arctic Coastal Plain following an October ice storm on the central Arctic Coastal Plain (Carroll 2005, Bieniek et al. 2018). The herd has been exposed to some oilfield development in the eastern portion of its range in recent years, including the construction of the Alpine Colville Delta-5 field and the GMT1 pad as well as exploratory ice roads and exploratory drilling.

Traditional knowledge affirms the importance of the area near Teshekpuk Lake and use of the narrow corridors on either side of the lake for the Teshekpuk Caribou Herd.

> *"The area to the southeast, the east and northeast of the lake, Teshekpuk Lake, which is critical caribou calving area. There are probably ten to fifteen thousand caribou that calve in that area each year. And also to the north of the lake, that entire area from the Beaufort Sea coast to along the northern edge of the lake and on over to the Ikpikpuk*

> *River area are all fairly crucial insect relief areas."* (Utqiaġvik) (BLM 1997a; **Appendix Y**)
>
> *"The west side [of the proposed area of development] is getting over into the Kogru River area in the area that was originally excluded from leasing because it's extremely important for waterfowl, nesting, and molting, and it's also very important as a caribou calving area."* (Utqiaġvik) (BLM 2003a; **Appendix Y**)
>
> *"Nearly all of the parturient cows move north through the narrow corridor between Teshekpuk Lake and the Kogru River. It would be very difficult to have any development in this corridor without the risk of seriously affecting the population."* (Utqiaġvik) (BLM 2004c; **Appendix Y**)
>
> *"Teshekpuk Lake continues to be one of the most biological productive areas in the circle polar arctic that should be protected. The area just south of the lake is extremely important for caribou calving of the Teshekpuk Lake Herd. The area north of the lake is critical for insect relief. The areas east and west of the lake have narrow gaps of land that are important migration corridors."* (Utqiaġvik) (BLM 2019a; **Appendix Y**)

Central Arctic Herd

Population Status—The Central Arctic Herd was estimated at approximately 5,000 animals when it was first described as a separate herd in the mid-1970s (Davis and Valkenburg 1978). The herd grew to its estimated peak of 68,000 animals by July 2010, then declined steeply to 23,000 by July 2016; the most recent estimate was 28,000 individuals in 2017 (Lenart 2015a, 2018; ADFG 2017). The herd decline between 2010 and 2016 was thought to be due to high adult mortality and to the emigration of some Central Arctic Herd caribou to the Porcupine Caribou Herd and Teshekpuk Caribou Herd (ADFG 2017).

Distribution and Movements—The main range of the Central Arctic Herd extends from the Colville River to the Canning River, and from the Beaufort Sea coast to the southern slope of the Brooks Range (Lenart 2015a, Nicholson et al. 2016, Prichard et al. 2019a). The Central Arctic Herd calves in two areas between the Colville and Canning rivers to the east of the NPR-A; the western segment calves west of the Sagavanirktok River near the Kuparuk oilfield and the eastern segment calves east of the Sagavanirktok River in an area with little development (Murphy and Lawhead 2000). In the 1980s, calving was relatively common in the Kuparuk oil field area but following construction, calving densities declined within approximately 4 km from active roads and pads (Dau and Cameron 1986, Cameron et al. 1992) and the area of highest calving density gradually shifted south of the main Kuparuk infrastructure (Nellemann and Cameron 1998, Cameron et al. 2005, Lenart 2015).

Some Central Arctic Herd caribou move west into the NPR-A in mid- to late summer, but large movements of the Central Arctic Herd west of the Colville River into the NPR-A are unusual and episodic (Prichard et al. 2019a). In one such movement in July 2001, approximately 6,000 Central Arctic Herd caribou moved west across the Colville River Delta into the northeastern NPR-A (Lawhead and Prichard 2002).

During summer, the Central Arctic Herd uses the Beaufort Sea coast for mosquito relief habitat, with the western segment often moving back and forth through the Kuparuk oilfield as mosquito conditions change (Murphy and Lawhead 2000). During some years, a large proportion of Central Arctic Herd animals move east towards the Canada Border in mid-summer (Prichard et al. 2019a). In fall, most Central Arctic Herd caribou move to winter range in or near the Brooks Range with the proportion north or south of the mountains varying among years (Arthur and del Vecchio 2009, Lenart 2015, Nicholson et al. 2016).

Muskox

Muskoxen were extirpated from Alaska in the mid-1800s (Lent 1998), but were reestablished near the western Alaska coast in 1935, to Barter Island and the Kavik River near today's ANWR in 1969 (Reynolds 1998), and to the west of the NPR-A near Cape Thompson in 1970 and 1977 (BLM 2012 Section 3.3.6.2).

After reestablishment, muskox numbers in northeastern Alaska increased and their northeastern range expanded to the Colville River on the west (Reynolds 1998), but the population subsequently declined. Predation by grizzly bears accounted for 58 percent of calf mortality and 62 percent of adult mortality from 2007 to 2011 (Arthur and Del Vecchio 2017) although pathogens and mineral deficiencies may have been contributing factors (Afema et al. 2017). Muskoxen are frequently observed on the east side of the Colville River (Lenart 2015b, Prichard et al. 2019a) and, although unusual, muskoxen groups have been sporadically observed in northeastern NPR-A since at least 1998 (BLM 2012 Section 3.3.6.2). One group of 20 muskoxen west of the Colville River apparently fell through thin ice on a lake southeast of Teshekpuk Lake and drowned during the winter of 2012-2013 (Lenart 2015b).

The Cape Thompson population largely ranges within 15-20 miles of the Chukchi Sea coast from the mouth of the Noatak River to Point Hope (Hughes 2016). The population increased 8 percent per year from 1970 to 1998, continued to grow slowly until 2005, and declined from 2005 to 2011. The population was estimated to include 227 muskoxen in 2013 (Hughes 2016). Animals from this population have been more widely scattered in recent years with small groups and large mixed sex-age groups observed in the upper Noatak and upper Colville River drainages (Hughes 2016).

Moose

Moose have been well established on the Arctic Coastal Plain since the 1940's (Carroll 2014). They occur at low densities on the Arctic Coastal Plain, and at somewhat higher densities in the foothills. Moose are widely distributed during summer but concentrated in riparian corridors with tall shrubs during winter. The largest winter concentrations of moose occur in the upper Colville River drainage (Mould 1977, Carroll 2014) but moose range has expanded coincident with a northward expansion of tall shrubs (Tape et al. 2016).

Traditional knowledge observations also identify the Colville River as important moose habitat.

> *"Basically on the Colville, between Anaktuvuk Pass and 20 miles up from Umiat is where you find the most concentration. They usually tend to gather around Umiat area, in about a 10 mile radius of Umiat, but basically on the river. That's where you find the bulk of the moose herd. It's always been like that due to probably the highest concentration of willows in that area."* (Utqiaġvik) (SRB&A 2013c; **Appendix Y**)

> *"They're basically in the Umiat area, that's where you tend to see the most concentration of rabbits is Umiat area. Probably about same as moose, where the willows are the thickest. Up the Chandler and up the Anaktuvuk River, but more in the main river."* (Utqiaġvik) (SRB&A 2013c; **Appendix Y**)

> *"It should also be known that leasing in the Colville River Special Area, this oasis is a riparian habitat is very productive and supports wildlife populations such as moose, hares, lynx, that are not abundant on the rest of the North Slope. It's an important area*

> *were North Slope people can harvest meat and fur trapping, conduct fur trapping."* (Nuiqsut) (BLM 2019e; **Appendix Y**).

The moose population on the Arctic Coastal Plain has generally followed a pattern of slow increase punctuated with periodic large and rapid declines, likely as a result of a combination of several factors including poor nutrition, disease, mineral deficiencies, predation, weather, and competition with snowshoe hares (Carroll 2014). Between 1970 and 1991, Game Management Unit 26A population increased slowly, then declined by about 79 percent between 1991 and 1999 (Carroll 2014). Populations again increased through 2008 but then another precipitous population decline occurred (Carroll 2014).

Of the 998 moose counted during the 2005 census, only 26 (2.5 percent) were seen in the NPR-A (Carroll 2005). The observed number of moose in the NPR-A compared to further east in the census area suggests moose winter habitat along rivers within the NPR-A can support fewer moose than the rivers further east.

Dall Sheep

Dall sheep habitat generally includes a combination of open alpine ridges, meadows, and steep slopes with rugged "escape terrain" nearby (Hull 1994). Dall sheep in the NPR-A are largely in the southern portion of the NPR-A in the De Long Mountains and Schwatke Mountains as described in BLM (2012 Section 3.3.6.4).

Carnivores

Carnivores species commonly found in the NPR-A include brown bear (grizzly bear), wolf, wolverine, arctic fox, and red fox. Boreal forest species such as marten and coyote are rare on the Arctic Coastal Plain but may occasionally be seen near the mountains along the southern planning area boundary. Lynx established themselves on the North Slope after snowshoe hares immigrated to and became plentiful in the Colville River drainage during the 1990s and have been seen as far north as Utqiaġvik (BLM 2012 Section 3.3.6.6).

Grizzly Bear—Grizzly bear densities on the western North Slope are generally highest in the foothills of the Brooks Range and lowest in the northern portion of the NPR-A. Densities in the Utukok River Watershed are higher than other areas of NPR-A, possibly as a result of Western Arctic Herd calving in the area (Carroll 2015). Densities were estimated at 0.1 to 0.5 bears per 100 square miles on the coastal plain (0.5 to 2/1,000 km^2), 3 to 8 bears/100 square miles in the foothills (10 to 30/1,000 km^2), and 3 to 5 bears/100 square miles (10 to 20/1,000 km^2) in the mountains. The population is thought to be stable or slowly increasing (Carroll 2015).

Grizzly bears are opportunistic omnivores whose food sources vary by region and season, but can include vegetation, small mammals, eggs, carrion, and ungulates. Caribou calves and arctic ground squirrels are important prey items in northwestern Alaska. East-west oriented ridges along the upper Colville River Watershed have been reported to be important bear habitat (Carroll 2015). In northeastern NPR-A, areas along rivers are important for foraging on vegetation as well as ground squirrels. During early summer, some bears move to coastal wetlands to forage on waterfowl eggs and nestlings (BLM 2012 Section 3.3.6.5). Grizzly dens on the Arctic Coastal Plain occur in pingos, banks of rivers and lakes, sand dunes, and steep gullies in uplands (Shideler and Hechtel 2000).

Wolf—Wolves are likely found throughout the NPR-A, at least on a seasonal basis. The population in Game Management Unit 26A was estimated to be 240 to 390 wolves in 32 to 53 packs in 1993 (Carroll 2012). The population declined in the late 1990s, possibly as a result of a decline in moose, but has likely increased since then (Carroll 2012). Wolves are less abundant on the coastal plain because of the seasonal scarcity of caribou, periodic outbreaks of rabies, hunting pressure, and better denning habitat near the mountains (Carroll 2000). Caribou and moose are their main prey, but during summer, they also feed on small mammals, snowshoe hares, and occasionally birds and fish (Ballard et al. 1997, Hull 1994).

Wolverine—Magoun (1985) estimated a fall population of 821 wolverines for the western North Slope (Game Management Unit 26A). Wolverines are omnivorous and prey upon and scavenge for caribou, relying heavily on arctic ground squirrels, caribou, and small mammals (Magoun 1985). Wolverines use tussock meadows, riparian willow, and alpine tundra (Magoun and Copeland 1998) and require deep snowdrifts for natal or maternal dens (Copeland et al. 2010). Wolverines have large home ranges and may occur at lower densities in areas with human development or harvest (Magoun and Copeland 1998, May et al. 2006, Gardner et al. 2010). Poley et al. (2018) found that wolverine in NPR-A preferred well-drained areas with rugged terrain and had higher occupancy in southern and eastern NPR-A.

Foxes—The arctic fox is the most common furbearer on the Arctic Coastal Plain, but their populations tend to fluctuate with the occurrence of rabies and changes in food availability. Arctic foxes den on the Arctic Coastal Plain but move long distances to forage extensively on sea ice during winter (Pamperin et al. 2008). Access to anthropogenic food sources can result in much lower winter movement rates (Pamperin et al. 2008; Lehner 2012). Red fox are found throughout the Arctic Coastal Plain, but especially along riparian drainages in the mountains and foothills (MacDonald and Cook 2009) and may be increasing in numbers. The red fox is dominant where the ranges of the two fox species overlap (Stickney et al. 2014), and may dig Arctic foxes from their dens and kill pups (Pamperin et al. 2006). Aerial surveys conducted by the NSB east of Wainwright resulted in an estimated density of 0.076 fox dens per km² (Prichard and Macander 2015), although the fox species was not determined. Both species of fox are important predators of birds and bird eggs.

Small Mammals

Small mammals provide important prey resources for predatory mammals and birds in the region, and arctic ground squirrels are especially important prey for grizzly bears and foxes (McLoughlin et al. 2002). Most species of small mammals exhibit cyclical population fluctuations, which have pronounced effects on local ecological systems (USFWS 2015). Arctic ground squirrels hibernate during winter, whereas lemmings, voles, and shrews remain active under the snow cover. Although abundance data is generally not available for the Arctic Coastal Plain, different small mammals have different habitat associations (Cook and MacDonald 2004).

Existing Infrastructure

Past development that may affect terrestrial mammals in the NPR-A includes the extensive oil and gas development to the east of NPR-A including the Prudhoe Bay, Milne Point, Kuparuk, and Point Thomson fields and smaller adjacent developments. The Central Arctic Herd has been exposed to oil and gas development for about 40 years. Mammals may also be exposed to human activity and hunting near local communities, the Red Dog Mine and road to the Chukchi Sea coast, and the TAPS and Dalton Highway. In recent years, oil and gas development has occurred in northeastern NPR-A with the extension of the Alpine oilfield from the Colville Delta to drill sites in NPR-A. New drill sites include Colville Delta-5 and GMT1. GMT2 has been permitted and is under construction. New construction currently in the permitting process under existing leases includes the Willow development southeast of Teshekpuk Lake and the Nanushuk development east of the Colville River delta. Winter seismic activity and exploratory drilling occurs annually in northeastern NPR-A. Recreationists, non-local hunters, and scientists contribute to human activity in the area, but only at a low level due to the remote nature of much of the NPR-A.

Climate Change

Climate change is expected to increase temperatures, increase precipitation, and lengthen the snow-free season. Summer temperatures above freezing could occur for 6 weeks longer by 2099 (SNAP 2011). The impacts of climate change are likely to vary by species, but in general, climate change will introduce significant uncertainty in predicting demographic trends of species in the area and will make the predicted impacts of development more difficult to accurately assess. Marcot et al. (2015) looked at habitat associations of 39 terrestrial mammals in northwest Alaska and reported that under one model, 6 and 16 species would increase and decrease, respectively, by at least 10 percent before 2100 as a result of climate change. Climate change appears to be resulting in a northward expansion of some mammal species, such as moose, beaver, and snowshoe hare. Beaver may be expanding into the NPR-A (Tape et al. 2015, 2016, 2018) and muskrat have been observed near Nuiqsut in recent years. Increasing numbers of red foxes due to warming could cause a decline in arctic foxes. Some species with low reproductive output in the Arctic, such as grizzly bears, may benefit from increased productivity and a more diverse prey base. Wolverine maternal dens could be impacted by the depth and duration of snowcover (McElvey et al. 2011, Magoun et al. 2017). Warming could also result in a spread of pathogens (Kutz et al. 2015). A large increase in the frequency of rain-on-snow events will limit access to forage for a variety of herbivores (Bieniek et al. 2018) including caribou and muskox (Berger et al. 2018).

Climate change in the Arctic is predicted to have multiple, sometimes counteracting, effects on caribou (Martin et al. 2009; Albon et al. 2016; Mallory and Boyce 2017). A longer snow-free season can increase access to forage (Cebrian et al. 2008; Tveraa et al. 2013), but changes in winter precipitation could increase energetic demands for cratering through snow and increases in rain-on-snow events could greatly decrease access to winter forage (Hansen et al. 2011; Albon et al. 2016; Loe et al. 2016) and increase mortality (Forbes et al. 2016). Higher summer temperatures could increase insect harassment (Weladji et al. 2003), the incidence of parasites, and the rate of annual decline in forage quality (Gustine et al. 2017). Changes in vegetation composition could lower forage quality (Fauchald et al. 2017). Increased moose densities could increase predator densities and alter predator distributions. Increases in wildfire could lead to lower lichen availability on the winter range (Joly et al. 2010).

Changes in timing of snowmelt and vegetation growth could potentially create a phenological mismatch between timing of calving and the emergence of highly nutritious forage (Post and Forchhammer 2008). Gustine et al. (2017) found no evidence of a spring nourishment mismatch for caribou in Alaska but suggested that one may occur in fall with increased warming. If mosquitos emerge closer to calving, it could result in a higher rate of separation of calves, poorer body quality of maternal caribou, and higher calf mortality. Earlier river breakup could alter the timing or difficulty of caribou migrations (Sharma et al. 2009; Leblond et al. 2016).

Overall, climate change is likely to have negative impacts on caribou. Climate change may have been a factor in a 56 percent decline in populations of migratory caribou and wild reindeer across the Arctic over the last 2 decades (Russell et al. 2019). Calving grounds tend to shift depending on the timing of snowmelt (Carroll et al. 2005, Dau 2007), so climate change could alter the location of calving grounds. Development alternatives that limit development near calving grounds would allow caribou greater flexibility to adapt to changing conditions.

Direct and Indirect Impacts

The effects of climate change described under the *Affected Environment*, above, are part of the baseline conditions for terrestrial mammals in the project area. See **Section 3.2.1** for a detailed discussion of the alternatives' contributions to global climate change.

Issuance of an IAP for NPR-A would define the stipulations and ROPs for a lessee to drill for and extract oil and gas subject to further environmental review and reasonable regulation, including applicable laws, terms, and conditions and is likely to lead to future exploration and development activities with potential indirect impacts of leasing. Such post-lease activities could include seismic and drilling exploration, development, reclamation, and transportation of oil and gas. In addition, to post-lease activities, there are also potential impacts of oil and gas activities not associated with a lease (e.g., seismic surveys of unleased areas and pipelines transporting oil and gas from offshore leases), as well as of non-oil and gas activities (e.g., construction of community infrastructure and scientific activities). Post-lease activities in the program area have the potential to affect terrestrial mammals through habitat loss and alteration, behavioral disturbance and displacement, and injury or mortality as a result of oil and gas exploration and development (**Table 3-29**). The impacts of oil and gas development on terrestrial mammals were previously summarized in the current NPR-A IAP EIS (BLM 2012 Section 4.4.9) and the impacts on caribou as well as existing mitigation measures have been summarized in various reviews (Shideler 1986; Cronin et al. 1994; Murphy and Lawhead 2000; NRC 2003; Lawhead et al. 2006). These references are incorporated here by reference and summarized below. Because specific project plans are not available for analysis, the areas available for leasing with and without restriction under each alternative were summarized in relation to the available data on terrestrial mammal distribution and in relation to predicted oil potential and hypothetical development scenarios (Appendix B, Map B-1). The effects of climate change described in the *Affected Environment* above, could influence the rate or degree of the potential direct and indirect impacts.

Table 3-29
Summary of the Type, Context, and Duration of Potential Effects of Oil and Gas Exploration, Construction, and Drilling and Operations on Terrestrial Mammals

Project Component	Potential Effect	Type	Context	Duration
Exploration	Elimination of under-snow habitat for small mammals	Adverse	Site-specific	Short-term
	Disturbance of active or denning mammals during winter	Adverse	Local	Short-term
	Change in phenology or damage to forage plants	Adverse	Site-specific	Short-term/ long-term
Gravel and pipeline infrastructure	Habitat loss from gravel fill placement	Adverse	Site-specific	Long-term
	Habitat alteration due to drifted snow, gravel spray, and dust deposition adjacent to gravel infrastructure	Adverse	Local	Long-term
	Early snowmelt due to dust deposition	Beneficial	Local	Long-term
	Displacement of caribou from infrastructure during calving	Adverse	Planning area-wide	Long-term
	Attraction of caribou to roads and gravel pads during oestrid fly harassment	Beneficial	Local	Long-term

Project Component	Potential Effect	Type	Context	Duration
	Disturbance and altered behavior due to noise and activities associated with construction and drilling and operation	Adverse	Local	Long-term
	Alteration of normal movement patterns and fragmentation of habitat due to roads and pipelines	Adverse	Local	Long-term
	Injury or mortality of large mammals due to vehicle strikes on gravel roads	Adverse	Site-specific	Long-term
	Injury or mortality of small mammals due to vehicle strikes on gravel roads	Adverse	Site-specific	Long-term
	Injury or mortality of small mammals in subterranean burrows	Adverse	Site-specific	Long-term
	Increased access for hunters	Adverse	Local	Long-term
Ice roads and pads	Habitat alteration due to drifted snow, delayed ice melt, vegetation compression, and hydrologic alteration from ice roads	Adverse	Local	Short-term
	Displacement from ice roads and ice pads due to noise and activity	Adverse	Local	Short-term
	Injury or mortality due to vehicle strikes on ice roads	Adverse	Site-specific	Short-term
	Injury and mortality of small mammals in under-snow habitats	Adverse	Site-specific	Short-term
Gravel Mine	Habitat loss due to gravel mining	Adverse	Site-specific	Long-term
	Habitat alteration from dust, water displacement, and hydrologic alteration at gravel mine	Adverse	Local	Long-term
	Displacement from gravel mine due to noise and activity	Adverse	Local	Long-term

Alternative A

Under this alternative, current management actions enacted by the current NPR-A IAP would be maintained, and resource trends and potential impacts would continue, as described in the current NPR-A IAP EIS (BLM 2012 Section 4.4.9). Potential activities include activities associated with oil and gas leases, oil and gas activities not associated with leases in the NPR-A, and non-oil and gas activities. Under Alternative A, 10,991,000 acres would continue to be closed to fluid mineral leasing, 2,492,000 acres would be subject to NSO, and 7,920,000 acres would be open subject to standard terms and conditions (**Table 2-1, Chapter 2**). Between 530 and 1,375 acres are expected to be covered in gravel for infrastructure associated with oil or gas leasing including gravel roads and pads. Gravel mining is expected to occur on 89–236 acres (see **Appendix B**, **Tables B-2** and **B-3**). A hypothetical schematic anchor-field footprint (one central processing facility and 6 radiating 8-mile access roads to 6 drill pads, including an seawater treatment plant pad and a 30-mile access road, totaling 750 acres) was calculated to have a 2.49 mile buffer of about 237,375 acres (BLM 2018 Section 3.3.4). Applying this ratio to the acres of gravel expected in Alternative A, suggests that between 168,000 and 435,000 acres would be within 2.49 miles of gravel roads or pads associated with oil or gas leasing, although this amount would vary substantially by project design and location.

Future seismic exploration is most likely to occur in areas in the specific areas where lease sales occur, but could occur in all areas open to lease sales. Seismic exploration has the potential to disturb caribou, muskoxen, wolves, denning and non-denning wolverines, and denning grizzly bears. Known locations of occupied grizzly bear dens would be avoided by at least one half-mile, although complete detection of dens is unlikely (Amstrup et al. 2004). Caribou are likely to be locally displaced from seismic activities. Russell (1977 cited in Garner and Reynolds 1986) reported that caribou within 800 m of seismic activity left the area (usually by walking) but the area was used by caribou again within 2 to 4 days after the activity ceased. A substantial portion of the Teshekpuk Caribou Herd remains on the Arctic Coastal Plain in most years (Person et al. 2007, Prichard et al. 2019a) and could continue to be disturbed by seismic exploration in the northern portion of NPR-A. Observations of local residents suggest that the winter distribution of caribou and other species is affected by seismic activity.

> *"Look at Nuiqsut. Couple years ago they were finally able to catch caribou around their town because -- three years ago there was seismic being done around Teshekpuk Lake, and what they did was take that herd around Teshekpuk that used to come here to Barrow to feed us, they chased it all the way over to Nuiqsut. And that winter we caught nothing here."* (Utqiaġvik) (MMS 2009a)

> *"The seismic activity has been moving further west, all over...They [oil industry] have been moving further and further west, and the caribou have been moving further and further west... The next year, it is further west, and that's where you find the end of the caribou. This year, where they last did seismic exploration, that's where you find the caribou. It seems like they've learned the exploration boundary, it seems like they're not crossing them [the boundaries] anymore."* (Utqiaġvik) (SRB&A 2013c)

> *"I think I've heard that concern now from two other persons that directly told me that the existing seismic is already impacting subsistence hunters as we speak, that the seismic area has no game. The impacts, like Harry said, has scared and run the game off in one direction from that area already and numerous trips made by at least half a dozen hunters have attested that,..."* (Utqiaġvik) (BLM 1997a; **Appendix Y**)

> *"and he just said, yeah I just ran into a set of wolverine tracks and followed them 26 miles one direction, and he didn't take a close look at the tracks and he started following the trail and it had just been scared away from where the activity was occurring, ... and he found the den and the rig had just gone by. I just happened to be there when he was following the trail and coming back, he said he just followed the trail 26 miles one direction and the wolverine had just made a bee line from where the seismic activity was going on, it had been scared away from its den, it was just moving out."* (Utqiaġvik) (BLM 1997a)

Seismic activity has been shown to temporarily displace muskox as far as two miles away (Clough et al. 1987). Reynolds and LaPlant (1985) found that muskoxen did not leave areas of traditional use following seismic activities, but two groups moved 1.2–3.4 mi following a close approach of seismic vehicles. Two groups ran when vehicles were over 1.9 mi away, but three groups did not run until vehicles were 100–400 m away. Muskoxen are currently rare in northeastern NPR-A where development is most likely to occur, but they occur regularly near the eastern border of NPR-A (Lenart 2015b).

Potential indirect effects of seismic exploration would also continue. These include short-term compaction of snow cover in used for foraging by herbivores and a decrease in below snow habitat for small mammals and blocking small mammal movements. The timing of spring snowmelt following seismic exploration would change as a result of snow compaction. Delayed snowmelt could decrease or alter the timing of forage available to caribou and other herbivores, but could also extend the time when highly nutritious, early growth forage is available after snowmelt. Some potential habitat alterations and long-term damage to forage plants, such as tussock cotton grass and riparian willow shrub, is also likely to occur (NRC 2003). Most seismic trails recover within 8 years, but the amount of long-term damage to vegetation that occurs would depend on snow depth, topography and habitat types (NRC 2003, Walker et al. 2019). Trails associated with camp-moves may result in more vegetation damage than seismic trails (NRC 2003, Walker et al. 2019). Some cleanup and other activities associated with seismic activities may occur during the summer resulting in additional disturbance to mammals. The timing of these activities could be managed to minimize these impacts.

All alternatives allow for application to construct permanent onshore pipelines and other infrastructure necessary to bring oil and gas from offshore leases to the TAPS in areas where new infrastructure is allowed. Properly designed and elevated pipelines not associated with roads do not appear to have large impacts on caribou midsummer movements although caribou may parallel the pipelines before crossing them (Prichard et al. 2018). The reactions are likely to be greater in the first years of exposure when caribou first encounter new infrastructure and delays and deflections are possible during this period.

Activities not associated with oil and gas activities will continue. This includes scientific activities including ground surveys and low-level helicopter and fixed-wing aircraft flights resulting in localized disturbance. Human activities associated with recreationists will also cause localized disturbance and small areas of degraded habitat. Human activities could result in some anthropogenic food sources for terrestrial mammals and possible defensive shooting of bears or other mammals. Subsistence hunting and hunting by non-local hunters will result in some direct mortality as well as some localized disturbance. Construction projects for local communities could result in some loss of habitat for terrestrial mammals. The potential impacts of a possible road project north of Teshekpuk Lake are described below.

Leasing

Oil and gas leasing would have no direct or indirect impacts on terrestrial mammals, but it is likely to lead to future exploration including seismic activity and potentially construction and operation of oil and gas facilities. Previously permitted projects will continue and future projects on existing leases will be subject to the permitting process and the BMPs, stipulations and ROPs in place at the time of the lease sale. In addition, other impacts not associated with a lease as well as non-oil and gas activities may occur and have potential impacts as described in other sections.

Exploration

Seismic activity is expected to occur in areas of lease sales with the potential impacts described above.

Exploration would also include exploratory drilling and construction and use of ice roads. Vegetation damage from future ice-road and ice-pad construction could reduce the abundance and quality of forage for terrestrial mammals, particularly caribou. The compaction of vegetation could reduce concealing cover for small mammals. Some long-term habitat damage would result from the repeated annual use of ice roads and pads. The use of ice-roads and ice-pads could result in disturbance and displacement of terrestrial mammals during the winter. These effects are likely to be similar to the effects of seismic lines; however, they will likely cover less area but be used for a more extended period.

Development

Oilfield development would continue to result in direct and indirect impacts on mammals under Alternative A (**Table 3-29**). This would include gravel mining, construction of ice roads, gravel roads, pipelines, airstrips, and pads with the associated drilling activity and noise, vehicle and aircraft traffic, and potential oil spills. Direct impacts would occur from gravel placement and ice road construction. These impacts would include loss of foraging and denning habitat, mortality and displacement of small mammals, and dust deposition on tundra adjacent to roads and airstrips. Direct mortality of terrestrial mammals could occur from vehicle strikes on gravel or ice roads. Caribou and other mammals attracted by early green-up of vegetation along gravel roads during spring snow melt would be at increased risk of injury or mortality. Caribou move rapidly and erratically during the oestrid fly season and often use gravel roads, pads, buildings and pipelines as relief habitat (Pollard et al. 1996, Noel et al. 1998, Prichard et al. 2019b), substantially increasing the risk of vehicle-related injury and mortality during that period. The use of vehicle management plans could lower the potential for vehicle strikes. Bears and foxes may be hazed from infrastructure or, in rare situations, may be killed in defense of life or property. Caribou and other large mammals may be hazed away from airstrips.

Potential indirect impacts on terrestrial mammals would continue to include habitat alteration, fragmentation, and loss of use of habitat because of disturbance or displacement. Habitat near gravel infrastructure is likely to be affected by physical alteration caused by dust deposition, gravel spray, thermokarst, flow alteration, changes in species composition, and impoundments. These effects could lower the amount of forage available to herbivores. Snowdrifts along roads would melt later in the spring temporarily restricting access to forage, but dust deposition from vehicle traffic will also lead to earlier snowmelt in areas adjacent to roads which could provide access to highly nutritious early emerging forage for caribou in the spring. Ice roads would have the effects described above.

Construction and drilling activities would continue to result in increases in light and noise from blasting, drilling, vehicle traffic and fixed wing aircraft and helicopter traffic. These would likely lead to local disturbance and avoidance of the areas of activity. Areas with consistently high levels of activity, such as near central processing facilities, airstrips, active construction, and busy sections of trunk roads and areas with loud noises such as blasting zones at gravel mines and airstrips are more likely to result in disturbance or displacement.

Permanent oil and gas facilities would continue to be prohibited at various distances from major rivers in the NPR-A (K-1), this will limit impacts to a variety of terrestrial mammal species that use riparian areas including moose and muskoxen and predators such as wolves and bears that might use prey on those species or use riparian areas as travel corridors. Caribou may also use riparian areas for oestrid fly-relief and for travel corridors to and from mosquito-relief habitat.

The primary issues of concern with oil and gas development and caribou involve: displacement of maternal caribou from infrastructure during calving; barriers to caribou movements especially to and from insect-relief areas; increased energetic costs due to disturbance and changes in activity budgets; and alteration of movements that might affect subsistence harvest location or success (Cronin et al. 1994, Murphy and Lawhead 2000, NRC 2003).

The Central Arctic Herd has been exposed to oil development for approximately 40 years and provides an extensive amount of research on the behavioral response of caribou to infrastructure as well as potential impacts, but there are several differences between the Central Arctic Herd and Teshekpuk Caribou Herd that may affect their response to infrastructure. The Teshekpuk Caribou Herd is subject to high subsistence harvest of approximately 10 percent per year (Parrett 2015) and much of the Teshekpuk Caribou Herd remains on the Arctic Coastal Plain all year, so Teshekpuk Caribou Herd caribou are likely to encounter oil and gas infrastructure during the winter. Unlike the Central Arctic Herd, the Teshekpuk Caribou Herd will be subject to hunting by local residents along oilfield roads. If hunting from the road occurs frequently, caribou could associate roads with hunting which may result in additional displacement and limit the opportunity for habituation (Paton et al. 2017, Plante et al. 2018) but the size of these effects will depend on the frequency and location of hunting.

Studies of Central Arctic Herd caribou have demonstrated that behavioral reactions are most common when caribou are within 656 feet of roads, but the strongest reactions, as measured in displacement distance, occur in response to humans on foot (Curatolo and Murphy 1986; Lawhead et al. 1993; Cronin et al. 1994). The response of caribou to infrastructure may attenuate following repeated non-negative exposures (Cronin et al. 1994, Murphy and Lawhead 2000). The Teshekpuk Caribou Herd and Western Arctic Herd have had less exposure to development than the Central Arctic Herd, but the Teshekpuk Caribou Herd has been exposed to oilfield and exploration activity on the eastern edge of their range, and both herds do have had some exposure to roads and development in other areas.

Research on the Central Arctic Herd following development of the Kuparuk and Milne Point oilfields suggests that during and immediately after calving, maternal caribou with young calves tend to avoid areas within 1.25 to 3.1 miles of active roads and pads (Dau and Cameron 1986; Lawhead 1988; Cameron et al. 1992; Cronin et al. 1994; Nellemann and Cameron 1996; Lawhead et al. 2004; Vistnes and Nellemann 2008; Prichard et al. 2019b) and caribou densities declined in areas with higher density of infrastructure (Nellemann and Cameron 1996). Aerial surveys conducted before and after construction of the Milne Point road indicated that caribou densities within 0-2.49 miles of the road decreased while densities 2.49–3.75 miles from the road increased (Cameron et al. 1992) after construction. Displacement occurs even with low traffic levels, but inactive infrastructure does not appear to cause similar levels of displacement (Lawhead et al. 2004). Displacement observed in the Central Arctic Herd lasts throughout calving (late May to mid-June) but after about three weeks, calves are more mobile and the level of displacement declines (Smith et al. 1994; Lawhead et al. 2004; Haskell et al. 2006; Prichard et al. 2019b).

When mosquito harassment occurs Teshekpuk Caribou Herd and Central Arctic Herd caribou move to the coast and the Western Arctic Herd moves to ridgetops in the Brooks Range where cooler and windier conditions typically result in reduced mosquito harassment (Parrett 2007, Person et al. 2007, Murphy and Lawhead 2000, Dau 2015). Caribou moving through oilfields to mosquito-relief habitat may be delayed or deflected during road or pipeline crossings. Elevating pipelines to a minimum height of 5 feet aboveground has been shown to be generally adequate to allow caribou crossing, although in areas where wintering caribou are present pipelines need to be adequately elevated to account for snow deposition. The requirement for 7-foot minimum pipeline height (BMP E-7) should be adequate during summer and in most areas during winter (Lawhead et al. 2006). Delays or deflections are more likely in areas where pipelines are adjacent to roads (<500 feet) and in areas with high traffic. Traffic rates of 15 vehicles per hour or more has been shown to increase the likelihood of deflected movements or delayed road crossings, even in the absence of pipelines (Curatolo and Murphy 1986; Cronin et al. 1994). When oestrid-fly harassment occurs, typically in mid-July to early August, some caribou will use gravel roads and pads and areas under buildings and pipelines as fly-relief habitat (Pollard et al. 1996, Noel et al. 1998, Prichard et al. 2019b), so development can provide a short-term beneficial effect during that season.

Observations of local residents suggest that caribou distribution and movements may be affected by pipelines.

> *"The migration of the Eastern Herd that comes through the Colville River has really changed since Alpine with all the pipelines. It's deflected the Teshekpuk Herd from the east and south; because of the pipeline changing their migration route. (Nuiqsut active harvester; Experience timeline: Since 1977 and ongoing; Experience location: Colville River."* (SRB&A Interview 2007) (SRB&A 2009)
>
> *"Nothing has been done. They say caribou can go under [pipelines], but sometimes they turn back. We mention that to oil companies, to bury the pipeline half a mile away from the coast so caribou can get away from mosquitoes. They say they can go under, but I don't see them go under. Especially along the coast, crossing Sagavanirktok River, then they could go along the coast."* (Nuiqsut active harvester. SRB&A Interview 2007) (SRB&A 2009)
>
> *"Alpine, it started happening since they build that pipeline. Some [caribou] go further north coming in. Especially when they build that pipeline, they really divert that caribou that used to come straight across before Alpine was here. The pipeline's just right over here. All that pipeline goes there and the Western Herd, before the pipeline, they used to go straight there. They really divert that caribou. All those caribou used to come from the eastern herd and go right through."* (SRB&A Nuiqsut Interview March 2009) (SRB&A 2010b)
>
> *"The pipelines, you know, maybe the caribous don't like to go through the pipeline even if they can go through, they hardly don't' do that anymore; they always have to go around somewhere. They always start to go up river and then up around Fish Creek. We can see tracks down by Ocean Point and then going up towards Fish Creek [circle around south and then back north toward Fish Creek]. There used to be big herds going through there almost every year. We would have lots of caribou in my area [before], they go by my house; bunch of caribou would be hanging around in that area and go over towards Fish Creek. Those pipelines, some of them are not too high, and some of them there are places for them to go through alright, but they always be scared or something, I don't know."* (SRB&A Nuiqsut Interview May 2010) (SRB&A 2010b)
>
> *"They go around the pipeline. Some of them [pipelines] are real low. Make sure they are seven feet [tall]. The older ones are those ones deflecting the caribou [new pipes are better, taller]."* (Nuiqsut) (SRB&A 2010b; **Appendix Y**)

Although Central Arctic Herd caribou navigate through the Kuparuk oilfield frequently through the summer (Murphy and Lawhead 2000, Prichard et al. 2019b), some short term delays and deflections occurred, especially in the years after development occurred (Johnson and Lawhead 1989, Lawhead et al. 2006). Several studies have reported longer-term delays during road crossings during migratory movements. Approximately 30 percent of collared female Western Arctic Herd and Teshekpuk Caribou Herd caribou (8 of 24 individuals) encountering the Red Dog Mine road in northwestern Alaska during fall migration experienced long delays in crossing the road corridor, with the delays of these "slow crossers" averaging 11 times longer than those of "normal crossers" (33.3 days vs. 3.1 days; Wilson et al. 2016). During the winter of 2003–2004, a large portion of the Teshekpuk Caribou Herd wintered in northeastern Alaska near Kaktovik following an October rain-on-snow event (Carroll 2005, Bieniek et al. 2018). These Teshekpuk Caribou Herd caribou exhibited some extended delays crossing the Dalton Highway, although a flooding Sagavanirktok River may have also caused delays in the spring (Carroll 2005). Wild reindeer (the same species as caribou) in Norway were delayed approximately 5 days during spring migration at a highway corridor experiencing high levels of human activity, but when human activity was low during fall migration, the road did not appear to pose an obstruction (Panzacchi et al. 2013). Some delays could occur when migrating Teshekpuk Caribou Herd or Western Arctic Herd encounter roads, but these delays are most likely if traffic levels are high. If hunting from the roads occurs, and if caribou have little previous exposure to development.

Spills of hydrocarbons and other fluids could potentially result in contamination of terrestrial mammals, or indirect effects through contaminated prey or forage plants. The impacts of spills will depend on the timing, location, and size of the spills as well as the type of fluid (see **Appendix I, Section I.2**). Most hydrocarbon spills will be small and occur on gravel, ice roads, or snow, but larger hydrocarbon spills are possible and some large (≥ 500 barrels) spills of produced water or seawater or likely. Spill cleanup activities could cause localized disturbance and displacement of mammals.

Aircraft noise during take-offs and landings could continue to result in disturbance and increased stress of nearby terrestrial mammals as well as an inability to hear biologically important sounds, such as predators, prey, or interspecific communication (Barber et al. 2010). Low-level aircraft may cause flight responses or temporary changes in caribou behavior (Maier et al. 1998; Reimers and Colman 2006). Helicopters would continue to be used to support construction, research and monitoring, survey, and summer cleanup activity and possibly for spill-response equipment deployment and maintenance. The level of aircraft activity would increase if road-less developments are implemented. Maier et al. (1998) found that caribou responses to low-level military jet overflights were low in late winter, moderate in midsummer, and strongest during post-calving, with females accompanied by young showing the strongest responses. Lawler et al. (2005) found that responses to military overflights during calving were variable but generally mild, and overflights did not result in higher calf mortality or increased movements of cow/calf pairs.

Miller and Gunn (1979) found that 53.6 percent of caribou exhibited an extreme response to helicopters flying by at low levels (<656 feet) but only 16.1 percent exhibited an extreme response at higher altitudes. A total of 28.6 percent of muskoxen exhibited extreme responses to helicopters, and the percentage declined for altitudes > 656 feet (Miller and Gunn 1979). The level of reaction increased with circling behavior, but the effect declined with repeated passes during a day. Valkenberg and Davis (1985) also found that habituation appears to lower the response of caribou to aircraft activity. Teshekpuk Caribou Herd caribou are currently exposed to significant levels of aircraft noise on the eastern portion of their range (Stinchcomb 2017, Stinchcomb et al. 2019). There are minimum flight altitudes stipulated in different areas during biologically important areas and seasons which would reduce disturbance of wildlife and subsistence hunters (BMP F-1). The largest disturbance levels are likely to occur for large cargo and passenger aircraft during takeoff and landing as well as for helicopters circling at low-levels (Miller and Gunn 1979).

Alternative A continues to close all of the Utukok River Uplands Special Area except for the northern section to fluid mineral leasing and new infrastructure. Oil and gas development is not currently expected to occur in southwestern NPR-A (**Appendix B, Section B.2**), but if development does occur in the area, the impacts on the Western Arctic Herd should be minor under Alternative A. During calving, approximately 83.3 percent of female Western Arctic Herd (based on Kernel Density Estimation) are expected to be in areas that are closed to leasing or NSO and only 1.5 percent are expected to be in areas open to fluid mineral leasing under standard terms and condition (**Appendix R**, **Table R-2**), and 82.3 and 4.3 percent of Western Arctic Herd female caribou are expected to be in areas closed to new infrastructure and available to new infrastructure, respectively during calving (**Appendix R**, **Table R-3**). Because caribou are highly mobile, a higher percentage of females may move through these areas at some point during a season.

Under Alternative A, at any one time, 77.8 percent of calving female Teshekpuk Caribou Herd caribou (based on Kernel Density Estimation) are expected to be in areas closed to leasing or NSO and 15.5 percent of calving females are expected to be in areas open to fluid leasing under standard terms and condition (**Appendix R**, **Table R-4**), 46.0 percent are expected to be in areas closed to new infrastructure and 39.3 percent are expected to be in areas available for infrastructure (**Appendix R**, **Table R-5**). When considering only areas thought to have high oil potential, 2.7 percent of calving females are expected to be in areas open to fluid leasing under standard terms and condition (**Appendix R**, **Table R-6**) and 12.8 percent are expected to be in areas available for infrastructure (**Appendix R**, **Table R-7**). Under Alternative A, 60.0 percent of high-quality habitat for calving (relative probability of use ≥ 0.5, based on Wilson et al. 2012) is closed to leasing or NSO and 28.9 percent is open to fluid mineral leasing under standard terms and condition (**Appendix R**, **Table R-8**) and 53.8 percent is available for new infrastructure (**Appendix R**, **Table R-9**). The area that is closed to leasing or NSO will protect the majority of the calving area, but caribou calving in the areas that are standard terms and condition only are likely to be displaced some distance from roads and pads as described above. Wilson et al. (2013) used simulations to estimate the disturbance of Teshekpuk Caribou Herd calving areas under the Alternatives considered in the current NPR-A IAP (BLM 2012 Section 2.3) and found that the percentage of high value calving habitat (relative probability of use ≥ 0.75) impacted ranged from 9 to 34 percent, with the selected alternative having the lowest impact. The demographic impact of this displacement will depend on the availability of alternative calving areas.

Caribou are thought to select calving areas based on a variety of factors that provide favorable conditions for calving. These may include low predator densities, the presence of early emerging highly nutritious forage, patchy snow cover that could lower visibility to predators, and access to nearby mosquito-relief habitat (Kuropat 1984, Eastland et al. 1989, Wilson et al. 2012). Although there has been some annual variability in calving distribution, the Teshekpuk Caribou Herd has exhibited a strong fidelity for calving near Teshekpuk Lake since the Teshekpuk Caribou Herd was identified as a separate herd in the 1970s (Davis and Valkenburg 1978). Displacement from these areas would therefore presumably lead to use of less preferred calving areas, but the demographic impacts of this are difficult to predict. The western segment of the Central Arctic Herd gradually shifted its calving area to the south of the Kuparuk and Milne Point developments (Murphy and Lawhead 2000, Wolfe 2000), but the herd generally continued to increase in size until 2010, although some potential demographic impacts have been reported. Parturition rates were lower for caribou calving west of the Sagavanirktok River and near development during 1988–1994 (Cameron et al. 1992, 2005) and Arthur and Del Vecchio (2009) found that calves on the west side had lower body mass in June, September, and March, but changes in mass during the summer and survival rates did not differ consistently between areas.

Two studies provide information on how displacement from preferred calving areas near Teshekpuk Lake could impact the Teshekpuk Caribou Herd. In the first study, Wilson et al. (2012) found that potential calving areas (area with similar characteristics to the calving areas used at that time) were limited in spatial extent, but in recent years increasing levels of calving also occurred in areas to the west of Teshekpuk Lake

(Parrett 2015, = Prichard et al. 2019a, Prichard et al. in press) in areas not predicted to have a high probability of use by Wilson et al. (2012). Whether or not these areas provided similar forage quality is not known. In the second study, Carroll et al. (2005) looked at calving success in different years. More Teshekpuk Caribou Herd calving occurred south of Teshekpuk Lake in years of late snowmelt and calving success was lower in those years. This may suggest that alternative calving habitat south of Teshekpuk Lake is of lower quality, however lower calving success in those years could also result from late springs rather than or in addition to the use of alternative areas for calving. Current or planned development east of Teshekpuk Lake may also limit the options for alternative calving areas available for the Teshekpuk Caribou Herd could force Teshekpuk Caribou Herd caribou to use areas of lower quality. Thus. the magnitude of the negative consequences resulting from calving displacement, if it occurred, is unknown but potentially large.

The ability of caribou to access mosquito-relief habitat near the coast is also a concern for development on the Teshekpuk Caribou Herd range. Because Teshekpuk Caribou Herd caribou move fastest during mid-summer (Person et al. 2007, Prichard et al. 2014) a large proportion of the Teshekpuk Caribou Herd could be exposed to any infrastructure constructed in high use areas of the mosquito season range. Under Alternative A, 84.2 percent of Teshekpuk Caribou Herd caribou are expected to be in areas closed to leasing or NSO during the mosquito season (**Appendix R**, **Table R-4**), but only 42.3 percent of the herd is expected to be areas closed to new infrastructure (**Appendix R**, **Table R-5**). Displacement from infrastructure is substantially lower during mid-summer than during calving (Smith et al. 1994, Haskell et al. 2006, Prichard et al. 2019b), but some delays and deflections could occur as described above. The protections in place for the areas north of Teshekpuk Lake and the narrow corridors on either side under Alternative A are likely to allow passage to and from this important caribou mosquito-relief habitat. K-5 adds additional protections for coastal areas used for mosquito-relief habitat and rapid movements of large mid-summer aggregations.

A total of 28.2 percent of female Teshekpuk Caribou Herd caribou are expected to be on areas closed to leasing or NSO during the winter, 29.2 percent in areas with standard terms and condition, 2.6 percent are expected to be in areas with BMP, and the rest are expected to be outside the planning area during winter (**Appendix R**, **Table R-4**). Male Teshekpuk Caribou Herd caribou are more likely to winter outside of NPR-A in the Brooks Range (Parrett 2015, Prichard et al. 2019a).

Wolverine may avoid areas of human activity (May et al. 2006; Gardner et al. 2010). A total of 22.7 percent of high occupancy areas for wolverines (expected occupancy ≥ 0.75; Poley et al. 2018) are closed to leasing or NSO and 16.8 percent are open to leasing under standard terms and condition (**Appendix R**, **Table R-10**). Only 5.1 percent of the high occupancy areas that are open to leasing under standard terms and condition are in areas of high oil potential.

Production

Many of the same impacts that occur during construction would persist throughout future drilling and operation, although some activities, such as gravel hauling, gravel fill placement, pipeline construction, would end and others, such as vehicle and air traffic volume, would continue at a lower frequency. Drill rigs and associated activity would introduce additional noise and disturbance. Because of the relative levels of activity associated with each phase, the potential impacts during development drilling would be greater than during operations production after drilling ceases.

Throughout future drilling and operations, most maternal female caribou with young calves would likely continue to avoid active infrastructure by about 2.49 miles and caribou moving through the program area during the post-calving and insect seasons could experience delays and deflections when encountering roads and pipelines, especially caribou with little exposure to development encountering roads with high rates of traffic (e.g., >15 vehicles per hour; Curatolo and Murphy 1986).

Abandonment and Reclamation

Abandonment and reclamation would occur for roads and well pads after wells stop being economically productive and is expected to occur from 2 to 5 years after production ends (**Appendix B**, **Section B.1**). Equipment and gravel would be removed, and efforts would be made to revegetate the area as specified in stipulation G-1. This would add small amounts of additional forage compared to the production phase. Reclamation activity could disturb terrestrial mammals in the local area, but the impacts would vary depending on the timing of the activity.

Impacts Common to All Action Alternatives

Under all action alternatives, the impacts from specific activities are likely to be similar to those described under Alternative A. The Teshekpuk Lake Special Area is modified under all action alternatives with the southern portion removed and additional acreage added to the west. The overall area declines by 4.9 percent (**Chapter 2**, **Table 2-1**), but areas to the west of Teshekpuk Lake that have been used for calving in recent years (Parrett 2015, Prichard et al. 2019a) will be added. The Colville River Special Area is eliminated but the raptor stipulations and BMPs associated with that area under Alternative A (K-12) that may also benefit terrestrial mammals are replaced by a stipulation (K-1) specifying NSO and no new infrastructure except essential road and pipeline crossings within 7 miles (Alternative B) or 3 mile (Alternatives C-D) of the Colville River.

Under all action alternatives, a vehicle management plan would be required (ROP E-1) and the BLM authorizing officer would be able to stop traffic for up to 4 weeks in a defined area to prevent displacement of calving caribou (ROP E-1 and E-7). Roads are required to be separated from pipelines when possible and a vehicle management plan is required (ROP E-7). ROP E-23 and K-10 would require a workshop to be convened to identify the optimal placement of infrastructure planned in the 50 percent Teshekpuk Caribou Herd calving kernel and caribou movement corridors. This workshop may lead to improved design which could enhance caribou movements through the area but is unlikely to substantially lower displacement of maternal caribou during calving. An area of 61,000 acres along Fish Creek in an area used by the Teshekpuk Caribou Herd would be closed to sand and gravel mining (K-1). All action alternatives would require elevated pipelines to have a nonreflective finish (ROP E-7). Observations of local residents suggest that reflective finishes affect caribou reactions to pipelines.

> *"Well, the pipeline is a problem. When you look at it, it is reflective. All that pipeline that comes to Alpine and goes to Kuparuk, it shines and it looks like ice out there. The caribou look at that and they are re-routed."* (Nuiqsut) (SRB&A 2010b; **Appendix Y**)
>
> *"The coating is too shiny. More likely…when we were riding on the ice roads one time, we could see quite a few caribou crossing but maybe in the summertime, due to the reflection of the sun, they don't want to cross. They'll pass right under the pipeline [in the winter]"* (SRB&A Nuiqsut Interview May 2010) (SRB&A 2010b; **Appendix Y**)
>
> *"Also the pipeline is so reflective that sometimes the caribou thinks that is the edge of the ocean, the ice pack, so that is why they go and travel further south of us."* (SRB&A Nuiqsut Interview May 2010) (SRB&A 2010b; **Appendix Y**)

> *"The pipeline, wish they could change it to make it more dull. They [the caribou] think it's ice, so they think they need to stop and go back from where they come from. Summer time I can see it from my house."* (Nuiqsut) (SRB&A 2014a; **Appendix Y**)

In addition to oil and gas infrastructure, there is interest in a community road connecting Nuiqsut to Utqiaġvik that would be routed north of Teshekpuk Lake. This road would have similar effects as other roads as described above. It would likely displace a substantial number of Teshekpuk Caribou Herd caribou during calving with the impacts described above. It could also disturb or displace caribou during the mosquito season, especially if traffic levels are high or hunting is allowed along the road. This road would cross through the narrow corridors near Teshekpuk Lake that are used by about 40-50 percent of Teshekpuk Caribou Herd caribou during July (Yokel et al. 2011) and cross through the primary Teshekpuk Caribou Herd mosquito relief habitat north of Teshekpuk Lake. During July Teshekpuk Caribou Herd caribou move faster than at any time of year (Person et al. 2007, Prichard et al. 2014) and a large proportion of the herd is often north of Teshekpuk Lake in large aggregations. This area has many large lakes and limited land area, so Teshekpuk Caribou Herd caribou would have to cross this road multiple times as they shift direction in response to wind and weather conditions. If access to mosquito-relief habitat was substantially delayed, this could have negative effects on caribou body condition which could lower future productivity. It could also alter the distribution or increase the amount of harvest by local and to a lesser extent, non-local hunters which would impact all game species and increase levels of human activity throughout a large area (subject to road use limitations and hunting regulations). Some low level of mortality from vehicle collisions would also occur.

The most substantial differences among action alternatives in the impacts to terrestrial mammals from fluid mineral leasing will result from differences among action alternatives in the areas that are subject to NSO, no new non-subsistence infrastructure, controlled surface use, timing limitations, or not available to leasing as described below. The impacts on large mammals are likely to be similar in nature under all action alternatives but vary largely in response to the amount of development occurring as well as any changes in hunting access or distribution. Limiting access to anthropogenic food sources (ROP A-2, A-8) will be important to limiting impacts on grizzly bears and Arctic and red foxes.

Alternative B

Under this alternative, between 476 and 1,236 acres are expected to be covered in gravel for roads and pads and gravel mining is expected to occur on an additional 80–212 acres (**Appendix B**, **Tables B-2** and **B-3**). Between 151,000 and 391,000 acres would be expected to be within 2.49 miles of gravel roads or pads associated with oil or gas leasing, although this would vary by project design and location. Under Alternative B 11,334,000 acres are closed to fluid mineral leasing, 3,791,000 acres are subject to NSO, and 7,629,000 acres area subject to standard terms and condition (**Chapter 2**, **Table 2-1**).

Although the Colville River Special Area in Alternative A is not included in Alternative B, permanent oil and gas facilities are prohibited within 7 miles of the Colville River (K-1). The area along the Colville River contains important moose habitat, is used by Teshekpuk Caribou Herd caribou during fall migration, and the upper Colville River contains high quality bear habitat. Alternative B also contains a lease deferral area near Nuiqsut that would delay leasing for at least 10 years (K-16). This area is used by both the Teshekpuk Caribou Herd and Central Arctic Herd during some seasons, so this deferral will limit impacts in this area for the period of the deferral. Alternative B recommends Wild and Scenic River designation for 12 rivers; this designation would decrease impacts on mammals in these riparian areas.

Alternative B closes all of the Utukok River Uplands Special Area to fluid mineral leasing and new infrastructure, and also adds the northernmost portion of the area that is open to leasing and new infrastructure under Alternative A. Alternative B does open some areas to the east that were in the Colville River Special Area to fluid mineral leasing and new infrastructure, but it maintains and extends most protections for areas used by the Western Arctic Herd for calving and mid-summer movements.

Approximately 85.9 percent of female Western Arctic Herd are expected to be in areas that are closed to leasing or NSO during calving and only 1.6 percent are expected to be in areas open to fluid mineral leasing under standard terms and condition (**Appendix R**, **Table R-2**), and 85.1 and 1.7 percent are expected to be in areas closed to new infrastructure and available to new infrastructure, respectively (**Appendix R**, **Table R-3**). Because caribou are highly mobile, a higher percentage of females may move through these areas at some point during a season. Oil and gas development is not currently expected to occur in southwestern NPR-A (**Appendix B, Map B-1**), but if it does the impacts on the Western Arctic Herd are expected to be minor under this Alternative and lower than under Alternative A.

Alternative B should provide additional protections for the Teshekpuk Caribou Herd relative to Alternative A. Under Alternative B, at any one time, 88.5 percent of calving female Teshekpuk Caribou Herd caribou are expected to be in areas closed to leasing or NSO and 8.2 percent of calving females are expected to be in areas open to fluid leasing under standard terms and condition (**Appendix R**, **Table R-4**), 77.4 percent are expected to be in areas closed to new infrastructure and 15.7 percent are expected to be in areas available for infrastructure or in infrastructure corridors (**Appendix R**, **Table R-5**). When considering only areas thought to have high oil potential, 1.3 percent of calving females are expected to be in areas open to fluid leasing under standard terms and condition (**Appendix R**, **Table R-6**) and 6.4 percent are expected to be in areas available for infrastructure or in infrastructure corridors (**Appendix R**, **Table R-7**), although some of the areas closed to leasing under Alternative B have already been leased. Because caribou are highly mobile, a higher percentage of females may move through these areas at some point during a season. Under Alternative B, 71.8 percent of high-quality habitat for calving (relative probability of use ≥ 0.5, based on Wilson et al. 2012) is closed to leasing or NSO and 22.8 percent is open to fluid mineral leasing under standard terms and condition (**Appendix R**, **Table R-8**) and 23.3 percent is available for new infrastructure (**Appendix R**, **Table R-9**).

The protections in place for the areas north of Teshekpuk Lake and the narrow corridors on either side of the lake provide should allow the Teshekpuk Caribou Herd to access preferred area during the mosquito season. The infrastructure corridor east of Teshekpuk Lake could hinder some caribou movements when they move through the narrow corridor near the lake, but with proper design, caribou would still likely cross a pipeline through this area. The possibility of delays or deflections would be higher in early years after construction. Alternative B provides additional areas closed to leasing in coastal areas compared to Alternative A (ROP K-5). Alternative B also provides additional protections relative to Alternative A during other seasons (**Appendix R**, **Table R-2**).

The potential impacts of Alternative B on wolverine are similar to impacts under Alternative A. A total of 23.5 percent of high occupancy wolverine areas (Poley et al. 2018) are closed to leasing or NSO and 19.7 percent are open to leasing under standard terms and condition (**Appendix R**, **Table R-10**). Only 5.1 percent of the high occupancy areas that are open to leasing under standard terms and condition are in areas of high oil potential.

Alternative C

Under this alternative, between 669 and 1,736 acres are expected to be covered in gravel by infrastructure including gravel roads and pads and gravel mining is expected to occur on 112–297 acres (**Appendix B, Tables B-2** and **B-3**). Between 212,000 and 549,000 acres would be expected to be within 2.49 miles of gravel roads or pads associated with oil or gas leasing, although this would vary by project design and location. Under Alternative C 5,701,000 acres are closed to fluid mineral leasing, 5,013,000 acres are subject to NSO, and 11,418,000 acres area subject to standard terms and condition (**Chapter 2**, **Table 2-1**).

Alternative C prohibits permanent oil and gas facilities within 3 miles of the Colville River (K-1). This area along the Colville River contains important moose habitat, is used by the Teshekpuk Caribou Herd during fall migration and includes high quality bear habitat along the upper Colville River.

Alternative C closes the Western Arctic Herd core calving area portion of the Utukok River Uplands Special Area to fluid mineral leasing and new infrastructure, but opens the southern portion of the special area as well as areas to the east that were in the Colville River Special Area to fluid mineral leasing and new infrastructure. This alternative maintains most protections for the Western Arctic Herd calving range and extends those protections to the northern part of the special area, but it allows development within areas used consistently by almost all of the Western Arctic Herd during spring migration and for large mid-summer movements through the Brooks Range (**Appendix A, Map 3-20**). Oil and gas development is not expected in this area (**Appendix B**, **Map B-1**), but if roads, buildings, and pipelines are built in this area, they could result in delays or deflections of large mid-summer movements of caribou. These effects would be larger in areas with high density development, roads with high traffic rates, roads near pipelines, or in areas where hunting occurs, but effects on caribou movements could be partly mitigated with proper design and limits on human activity. Large caribou groups have been reported to have more difficulty crossing roads and pipelines (Curatolo and Murphy 1986), but this conclusion may be confounded by insect conditions and traffic (Lawhead et al. 2006). Based on herd size, mid-summer aggregations of Western Arctic Herd caribou may be much larger than Central Arctic Herd groups that navigate oilfields during mid-summer. The size of these Western Arctic Herd aggregations adds additional uncertainty to predicting their ability to navigate development.

Approximately 80.7 percent of female Western Arctic Herd are expected to be in areas that are closed to leasing or NSO and 6.9 percent are expected to be in areas open to fluid mineral leasing under standard terms and condition during calving (**Appendix R**, **Table R-2**), and 79.5 and 7.0 percent are expected to be in areas closed to new infrastructure and available to new infrastructure, respectively (**Appendix R**, **Table R-3**). Because caribou are highly mobile, a higher percentage of females may move through these areas at some point during a season. Oil and gas development is not currently expected to occur in southwestern NPR-A (**Appendix B, Map B-1**), but if it does the impacts on the Western Arctic Herd should be minor under this Alternative, but somewhat higher than under Alternative A, especially if development delays mid-summer movements through the Brooks Range.

Under Alternative C, at any one time, 72.2 percent of calving female Teshekpuk Caribou Herd caribou are expected to be in areas closed to leasing or NSO, 12.9 percent are expected to be in areas with timing limitations and 11.6 percent of calving females are expected to be in areas open to fluid leasing under standard terms and condition (**Appendix R**, **Table R-4**), 44.5 percent are expected to be in areas closed to new infrastructure and 41.8 percent are expected to be in areas available for infrastructure or in infrastructure corridors (**Appendix R**, **Table R-5**). When considering only areas thought to have high oil potential, 3.7 percent are expected to be in areas with timing limitations, 2.4 percent of calving females are expected to be in areas open to fluid leasing under standard terms and condition (**Appendix R**, **Table R-6**) and 15.4 percent are expected to be in areas available for infrastructure or in infrastructure corridors (**Appendix R**, **Table R-7**). Because caribou are highly mobile, a higher percentage of females may move through these areas at some point during a season. Under Alternative C, 50.9 percent of high-quality habitat for calving (relative probability of use ≥ 0.5, based on Wilson et al. 2012) is closed to leasing or NSO, 12.8 has timing limitations, and 30.4 percent is open to fluid mineral leasing under standard terms and condition (**Appendix R**, **Table R-8**) and 53.4 percent is available for new infrastructure (**Appendix R**, **Table R-9**).

Because the areas closed to leasing or NSO are not contiguous (**Appendix A, Map 2-3**), some development could occur near the high density Teshekpuk Caribou Herd calving areas resulting in displacement with the potential impacts described above. Limiting major construction activities could potentially lower the amount of displacement, but caribou are displaced from roads even with low traffic rates (e.g., up to 4 convoys per day; Lawhead et al. 2004). The authorized officer can stop traffic for up to 4 weeks. Displacement from inactive infrastructure appears to be limited (Lawhead et al. 2004), so this stipulation could lower the degree of calving displacement if implemented, however implementation is not required.

The protections in place for the areas north of Teshekpuk Lake and the narrow corridors on either side of the lake provide protection for Teshekpuk Caribou Herd during the mosquito season. Alternative C provides more limited protections relative to Alternative A during most other seasons (**Appendix R**, **Tables R-4** to **R-9**).

A total of 16.2 percent of high occupancy wolverine areas (Poley et al. 2018) are closed to leasing or NSO and 26.5 percent are open to leasing under standard terms and condition (**Appendix R**, **Table R-10**). Only 5.7 percent of the high occupancy areas that are open to leasing under standard terms and conditions are in areas of high oil potential. The impacts on wolverines are therefore likely to be somewhat higher under Alternative C than under Alternative A.

Alternative D

Under this alternative, between 919 and 2,385 acres are expected to be covered in gravel by infrastructure including gravel roads and pads and gravel mining is expected to occur on 154–409 acres (.49 miles of gravel roads or pads associated with oil or gas leasing, although this would vary by project design and location. Under Alternative D 4,430,000 acres are closed to fluid mineral leasing, 4,653,000 acres are subject to NSO, and 12,070,000 acres are subject to standard terms and conditions (**Chapter 2**, **Table 2-1**).

The stipulations for the areas along the Colville River are the same as Alternative C (K-1). And stipulations regarding the Western Arctic Herd are the same as Alternative C (K-14).

Under Alternative D, at any one time, 31.9 percent of calving female Teshekpuk Caribou Herd caribou are expected to be in areas closed to leasing or NSO, 6.7 percent in areas with controlled surface use, 44.9 percent in areas with timing limitations and 13.3 percent in areas open to fluid leasing under standard terms and condition (**Appendix R**, **Table R-4**), 14.6 percent are expected to be in areas closed to new infrastructure and 67.5 percent are expected to be in areas available for infrastructure (**Appendix R**, **Table R-5**). When considering only areas thought to have high oil potential, 6.3 percent are expected to be in areas with controlled surface use, 28.8 percent in areas with timing limitations, and 2.4 percent of calving females are expected to be in areas open to fluid leasing under standard terms and condition (**Appendix R**, **Table R-6**) and 38.6 percent are expected to be in areas available for infrastructure or in infrastructure corridors (**Appendix R**, **Table R-7**). Because caribou are highly mobile, a higher percentage of females may move through these areas at some point during a season. Under Alternative D, 21.1 percent of high-quality habitat for calving (relative probability of use ≥ 0.5, based on Wilson et al. 2012) is closed to leasing or NSO, 5.9 percent is controlled surface use, 35.7 percent has timing limitations, and 31.5 percent is open to fluid mineral leasing under standard terms and condition (**Appendix R**, **Table R-8**) and 74.3 percent is available for new infrastructure (**Appendix R**, **Table R-9**).

Much of the calving area is open to leasing with controlled surface use and available for new infrastructure (**Appendix A, Map 2-4**),. Depending on the location of development, this alternative could result in substantial displacement from current calving areas with the potential impacts on caribou survival, body condition and productivity as described above. Limiting major construction activities could potentially lower the amount of displacement, but caribou are displaced from roads even with low traffic rates (Lawhead et al. 2004). The authorized officer can stop traffic for up to 4 weeks. Displacement from inactive infrastructure appears to be limited (Lawhead et al. 2004), so this stipulation could lower calving displacement if implemented, however implementation is not required. The scale of the impacts would depend on the availability and quality of alternative calving areas as well as predator levels in alternative areas. If alternative calving areas have higher predator densities or lower habitat quality, as suggested by Wilson et al. (2012), there could be negative impacts on calf survival and negative effects on body condition and future productivity of maternal females. Substantial displacement could also result in longer movements between calving areas and mosquito-relief habitat which could also lower caribou body condition. Because a substantial portion of calving Teshekpuk Caribou Herd females could be displaced from preferred calving areas, the impacts on herd demographics are difficult to predict but could potentially be large. Increased use of late summer and winter range during calving could also decrease forage quality during those seasons.

Alternative D has limited protections in place for the areas north of Teshekpuk Lake and the narrow corridors on either side of the lake used extensively during the mosquito season (**Map 2-4**; **Appendix D**). This could result in substantial delays or deflections in movements to mosquito-relief areas with the potential for impacts on body condition and productivity. These impacts could be partially mitigated with proper oilfield design and placement. Protections for molting geese (K-6 and K-7) may provide some limited protections for caribou as well. Areas within 1 mile of the coast are NSO and allow no new infrastructure, except essential coastal infrastructure (K-5) which would facilitate some movements near the coast during the mosquito season. Alternative D provides fewer protections relative to Alternative A during most other seasons (**Appendix R**, **Tables R-4** to **R-9**).

A total of 15.5 percent of high occupancy wolverine areas (Poley eta l. 2018) are closed to leasing or NSO and 26.5 percent are open to leasing under standard terms and condition (**Appendix R**, **Table R-10**). Only 5.7 percent of the high occupancy areas that are open to leasing under standard terms and condition are in areas of high oil potential. The impacts on wolverine are therefore likely to be somewhat higher under Alternative D than under Alternative A and similar to Alternative C.

Cumulative Impacts

Cumulative impacts will occur in areas regularly used by terrestrial mammals in the NPR-A. Because of their extensive movements, this area can be delineated by the annual ranges of the three caribou herds regularly using the NPR-A (Western Arctic Herd, Teshekpuk Caribou Herd, and Central Arctic Herd). The temporal scope of these effects extends from the 1970s through 70 years after the ROD signing.

Potential future development projects outside of NPR-A and within the range of these caribou herds include multiple expansions of oil and gas infrastructure east of the NPR-A and near existing oilfields, potential leasing in the ANWR, and gas line projects that would add pipelines and other infrastructure adjacent to the existing TAPS corridor. These projects will have additive impacts on the Central Arctic Herd as well as other terrestrial mammals using the central Arctic Coastal Plain. Teshekpuk Caribou Herd caribou may have some limited exposure to these development projects. Increasing the proportion of time caribou are exposed to infrastructure could increase energetic impacts. This effect is unlikely to have large demographic impacts on caribou without high levels of exposure (Murphy et al. 2000), but high density infrastructure can cause calving to shift their calving distribution (Nellemann and Cameron 1998) and decrease available foraging areas. Development that displaces caribou from calving areas, hinders caribou movements among seasonal ranges, or increases hunter access are likely to have the biggest impact on caribou.

The effects of climate change, described in the *Affected Environment* section, could influence the rate or degree of the potential cumulative impacts. Red foxes are displacing arctic foxes in parts of the Arctic as a result of warming climates, (Pamperin et al. 2006; Stickney et al. 2014), but the presence of anthropogenic food sources from development could increase the rate at which this occurs (Savory et al. 2014; Elmhagen et al. 2017). Additional infrastructure in NPR-A could increase the spread of red fox across the Arctic Coastal Plain, the effect is likely to be additive. Large predicted increases in the frequency of rain-on-snow events in the Arctic and other climate change impacts could cause large declines in caribou body condition in the spring, making caribou more susceptive to impacts from development. Caribou may also abruptly change their wintering areas in response to rain-on-snow events (Bieniek et al. 2018) which may result in more interaction with infrastructure and limit the available options for wintering caribou.

In addition to a potential community road from Nuiqsut to Utqiaġvik, there is a potential for several other road projects. A potential road from the Dalton Highway extending west to the Ambler Mining District on the south side of the Brooks Range would cross Western Arctic Herd winter range. Wilson et al. (2014) modeled the importance of areas along that route for wintering Western Arctic Herd caribou and found that 1.5–8.5 percent of high-value winter habitat in the area may be reduced in quality. They concluded that this effect would be minimal, but increased access by recreationists and hunters may have a larger impact on caribou. Any road that increases hunter and trapper access could impact terrestrial mammal game species along the road route and access to navigable rivers and off-highway vehicles trails could expand the area accessible to hunters further. Because the main effects of this road would be on Western Arctic Herd caribou and terrestrial mammals in the local area, the additive impacts from the NPR-A leasing process are likely to be minimal.

A potential road between the Dalton Highway and Umiat could have similar impacts but would have more impact on caribou of the Teshekpuk Caribou Herd and Central Arctic Herd. This road could impact spring and fall migratory movements, the impact would be larger with high levels or traffic or if hunting is allowed along the road. The ASTAR project envisions multiple roads connecting NSB communities across the Arctic Coastal Plain. The location of these roads remains speculative but would likely cross some Western Arctic Herd, Teshekpuk Caribou Herd, or Central Arctic Herd migratory routes or calving areas and increase hunter access with the potential impacts described above. The total infrastructure within a caribou herd's range will increase the disturbance levels and limit options for seasonal ranges, with the largest impacts occurring for infrastructure on the calving range. The impacts of displacement of calving caribou will largely depend on the alternatives available. If alternative calving areas have higher predation rates or lower forage quality, it could result in lower survival or productivity. Existing and planned infrastructure on the eastern side of the Teshekpuk Caribou Herd annual range will limit options for alternative calving habitat area if maternal females are displaced from current calving areas by development.

3.3.6 Marine Mammals

Affected Environment

All marine mammals found in U.S. waters are protected under the Marine Mammal Protection Act (MMPA), as amended (16 USC 1631 et seq.). Some species receive additional protection under the ESA (16 USC 1531 et seq.). Whales, seals, Stellar sea lions, and porpoises are managed by the National Marine Fisheries Service (NMFS), whereas polar bears, walruses, and northern sea otters, are managed by the USFWS. The NMFS and USFWS stock assessment reports contain detailed information on the status, seasonal distribution, abundance, and life history of marine mammals in the Beaufort, Chukchi, and Bering seas (Muto et al. 2018; https://www.fisheries.noaa.gov/topic/marine-mammal-protection; and https://www.fws.gov/alaska/pages/marine-mammal-management). NMFS (2016a) provides detailed descriptions of marine mammal population status and trends, distribution, seasonal migration and movements, habitat use, reproduction and growth, survival, and mortality. Additional information is available in the 2012 NPR-A IAP (BLM 2012) and in the EIS for the Liberty development project (BOEM 2018). These documents are incorporated into this EIS by reference.

The analysis area for marine mammals includes the coastal and estuarine areas of the NPR-A, marine waters within 5 miles of the NPR-A boundary, and the vessel transit route between the NPR-A and Dutch Harbor (**Appendix A, Map 3-23**). The 5-mile buffer was selected to encompass the area likely to be affected by shipping activity, ice roads, and sound propagation from coastal activities into the marine environment. Eleven species of marine mammals occur in and near NPR-A, including 7 cetaceans, 4 pinnipeds, and the polar bear (**Appendix S, Table S-1**); four of these species are listed as threatened or endangered under the ESA. Five additional species of marine mammals occur along the vessel transit route. The discussion below focuses on the ESA-listed species and others of importance for subsistence and cultural practices. Species that are rare within the planning area and occur primarily along the shipping route of the analysis area (e.g., ribbon seals, minke whales, fin whales, killer whales, narwhals, harbor porpoises) are not discussed, as they have been described in other documents (BLM 2012, NMFS 2016).

Pinnipeds

Spotted Seal. One of 3 distinct population segments of spotted seals (*Phoca largha pallas*) occurs in U.S. waters: the Bering distinct population segments (Boveng et al. 2009, NOAA no date). The other 2 distinct population segments occur in waters of China and Russia. There are no accurate abundance estimates for spotted seals across their range or specifically for the Bering distinct population segments (Muto et al. 2018). Analysis of a subset of surveys conducted in spring 2012 and 2013 indicate that 461,625 spotted seals (95 percent CI: 388,732–560,348) are present in the U.S. portion of the Bering Sea (Conn et al. 2014).

Spotted seals are widely distributed on the continental shelf of the Bering, Chukchi, and Beaufort seas, with pupping and breeding occurring primarily south of Bering Strait from March to June (Burns 1978; Lowry et al. 1998, 2000; Boveng et al. 2009). They are associated with the front zone of pack ice in winter and early spring when giving birth, raising pups, and molting (Quakenbush et al. 2009). As the ice melts, spotted seals may move northward and offshore, but generally stay in waters less than 200 m deep (Frost et al. 1983, Lowry et al. 2000). They also make use of land-based haul-outs including Kasegaluk Lagoon (especially the Utukok and Akoliakatat passes), the mouth of the Kuk River (Wainwright), and the mouth of the Kugrua River (Peard Bay area) (Frost et al. 1993, Citta et al. 2018) (**Appendix A, Map 3-26**). Observations from local residents and satellite telemetry indicate that spotted seals can travel up to 30 km up the Kukpuk River to feed on salmon and smelt (Frost et al. 1983).

Spotted seals have an estimated auditory bandwidth of 56 Hz–75 kilohertz (kHz) in water and 11 Hz–30 kHz in air (Southall et al. 2007, Sills et al. 2014). They produce 6 underwater sounds in frequencies that range from 500 Hz to 3.5 kHz (Frankel 2009).

Whales

Gray Whale. Gray whales (*Eschrichtius robustus*) are grouped into 2 distinct population segments: the Eastern North Pacific stock that feeds in the Beaufort, Chukchi, and Bering seas in summer and the Western North Pacific stock which is listed as endangered and is found primarily in Russian waters. The Eastern North Pacific stock migrates south from Alaskan waters in the fall to spend winter in waters off California and Mexico. The most recent population estimate of 20,990 individuals (CV = 0.05) is calculated from systematic counts of gray whales migrating south along the central California coast (Durban et al. 2015).

Gray whales from the eastern North Pacific regularly occur near Utqiaġvik in both Chukchi and Beaufort waters in summer (Moore and DeMaster 1997, Laake et al. 2009). They have been recorded during aerial surveys (Clarke et al. 2015) and on acoustic recorders (Moore et al. 2000, 2006), and may be expanding their feeding range into the Arctic as sea-ice coverage declines (Moore and Huntington 2008). They feed on a variety of benthic invertebrates and have experienced several episodes of starvation (LeBoef et al. 2000, Moore et al. 2003), including several carcasses washing up in Alaska in spring and summer 2019.

Gray whales have an estimated auditory bandwidth of 7 Hz–22 kHz, placing them in the low-frequency hearing group for cetaceans. They produce signals from 100 Hz to 4 kHz, with the most common sounds on the feeding grounds being knocks (BLM 2012).

Beluga Whale. Beluga whales (*Delphinapterus leucas*) in Alaska are grouped into five stocks (O'Corry-Crowe et al. 1997, 2002): one restricted to Cook Inlet and outside of the program area, two occurring in waters adjacent to the NPR-A (the Eastern Chukchi and Beaufort Sea stocks), and two of which may occur along the marine transport route (the Bristol Bay and eastern Bering Sea stocks, with a possible sixth stock in Kotzebue Sound). The northern stocks are the most numerous, with an estimated 39,258 individuals in the Beaufort Sea stock and 20,752 individuals in the eastern Chukchi Sea stock (Muto et al. 2018). The Beaufort Sea stock overwinters in the western Bering Sea and moves north to summering areas in the Canadian Beaufort Sea in April and May, typically staying within 40 mi of the Chukchi Sea coast (Richard et al. 2001, Hauser et al. 2014). The eastern Chukchi Sea stock overwinters in the northern Bering Sea and migrates north to the Chukchi Sea in late spring and early summer, passing Kasegaluk Lagoon in mid- to late June (Suydam 2009). They spend the summer feeding near Barrow Canyon and in the western Beaufort Sea before returning south to the Bering Sea during late fall.

The Chukchi and Beaufort stocks of belugas use waters near NPR-A as migration corridors and for feeding during the summer. They tend to congregate in areas with upwelling or other physical features that concentrate prey, such as in the passes or breaks in the barrier islands that border Omalik and Kasegaluk lagoons, in Kuk Inlet, or within Barrow Canyon (Suydam 2009, Stafford et al. 2016). Belugas may occur as solitary animals or in small groups; they can also occur in large pods of over 1,000 individuals. These large groups can be found near rocky beaches or in brackish water where they may go to molt (St. Aubin et al. 1990) or to provide protected areas for calves, which are born in June and July (BLM 2012).

Belugas are an important subsistence resource for communities along the Chukchi coast, and are occasionally harvested by Beaufort Sea communities as well. Residents in Point Hope and Utqiaġvik harvest whales from the shorefast ice in spring. Point Lay and Wainwright conduct community hunts in June when migrating whales can be herded into the lagoons (Suydam 2009, Frost and Suydam 2010).

Residents of Kaktovik, Nuiqsut, and Utqiaġvik may land whales in late summer or fall (Frost and Suydam 2010).

The eastern Bering Sea stock (6,994 whales) and the Bristol Bay stock (1,926 whales) remain in the Bering Sea year-round, with the Bering Sea stock spending summer in Norton Sound and near the mouth of the Yukon River and migrating south to Bristol Bay in winter (Suydam 2009, Hauser et al. 2014, Citta et al. 2018). The Bristol Bay stock shows only small seasonal shifts in distribution.

Beluga whales are the most vocal of the toothed whales and have a wide variety of vocalizations. They have as many as 50 different whistles and calls in frequencies ranging from 0.1 to 12.0 kHz (BLM 2012). They can detect sounds at frequencies as low as 40–125 Hz (Richardson et al. 1995).

Other Whales and Porpoises. Species of whales and porpoises that may be encountered within the analysis area are listed in **Appendix S, Table S-1**. Of the six stocks of killer whales that occur in Alaska, two stocks may occur in the analysis area: the Alaska Resident stock that occurs from southeastern Alaska to the Bering Sea could be encountered along the transit route, and the Gulf of Alaska, Aleutian Islands, and Bering Sea Transient stock that can occurs in the Chukchi and Beaufort seas. Neither stock is listed under the ESA or considered depleted under the MMPA (NMFS 2016, Muto et al. 2018). Killer whales are occasionally reported in the northeastern Chukchi Sea attacking gray and beluga whales and bearded seals, and possibly foraging on fish. They have rarely been recorded in the Beaufort Sea east of Utqiaġvik (Lowry et al. 1987; Clarke et al. 2013, 2015). Killer whales produce a variety of sounds including clicks, whistles, and pulsed calls in frequencies ranging from 0.5 to 25 kHz (Ford 2009, Department of the Navy 2011). The frequency range of hearing is 1–100 kHz, with the highest sensitivity at 20 kHz (Department of the Navy 2011).

Minke whales are believed to be migratory summer residents of the Chukchi and Bering seas, and move south of the Bering Sea to overwinter (Muto et al. 2018). Harbor porpoises are the smallest cetacean that occurs in the Arctic. The Bering Sea stock comprises 48,215 individuals that occur from the Aleutian Islands north to Point Barrow (NMFS 2016, Muto et al. 2018). They occur rarely near Point Barrow, although the increase in frequency of occurrence over the past 20 years may represent a range expansion (Funk et al. 2010, Hamilton and Derocher 2018, Whiting et al. 2011). Dall's porpoises are widely distributed in the deep (≥2,500 m) oceanic water and over the continental slope of the Bering Sea (Friday et al. 2013, Muto et al. 2018). They are not listed as depleted under the MMPA or threatened or endangered under the ESA.

Special Status Species

Polar Bear

Comprehensive syntheses of population status, distribution, and life history data on polar bears (*Ursus maritimus*) in the Chukchi and Beaufort seas are available in the Final Environmental Impact Statement (FEIS) for Effects of Oil and Gas Activities in the Arctic Ocean (NMFS 2016a), the Polar Bear (*Ursus maritimus*) 5-Year Review: Summary and Evaluation (USFWS 2017), and the FEIS for the Liberty Development and Production Plan (BOEM 2018). The following text summarizes these documents, which are incorporated by reference, and provides additional or updated information where available.

Polar bears have a circumpolar distribution in the northern hemisphere with 19 subpopulations (stocks) identified throughout their range, each numbering several hundred to several thousand animals and totaling approximately 26,000 individuals worldwide (95 percent CI = 22,000–31,000; Wiig et al. 2015, Atwood et al. 2016). The Chukchi/Bering Sea (CBS) stock and the Southern Beaufort Sea (SBS) stock are most likely to occur in the analysis area (Bethke et al. 1996, Amstrup 2003, Amstrup et al. 2004, Schliebe et al. 2006, Obbard et al. 2010, Durner et al. 2018). The CBS stock is genetically similar to the SBS stock, but demographic and movement data suggest that the stocks should be managed separately (Amstrup 2002, 2004, 2005).

The CBS stock is managed by the U.S. and the Russian Federation and this stock's boundaries are currently described differently by management and scientific organizations (BOEM 2018). The Agreement between the United States of America and the Russian Federation on the Conservation and Management of the Alaska–Chukotka Polar Bear Population describes the western boundary as the mouth of the Kolyma River, Russia, and its eastern boundary as a line extending north from Point Barrow, Alaska (Obbard et al. 2010). The Polar Bear Specialist Group describes the northwestern boundary as Chauniskaya Bay, in the East Siberian Sea, while the northeastern boundary is near Icy Cape, Alaska (Obbard et al. 2010; USFWS 2016).

The most recent population estimate for the CBS stock is 2,937 bears (95 percent CI = 1,552–5,944 bears) (Regehr et al. 2018). Prior to that estimate being published, the IUCN Polar Bear Specialist Group, considered the size of the population to be unknown due to data deficiency (USFWS 2016). The CBS stock overlaps with the SBS stock from Point Hope to the Colville River delta (USFWS 2010). Despite this range overlap, there are measurable differences in the ecological indicators of population health between the two stocks. A comparison of bears captured in the Chukchi and the Beaufort seas in spring 2008–2011 reported that polar bears from the CBS stock had larger body size, better body condition, and higher recruitment compared to the SBS stock (Rode et al. 2014).

The SBS stock ranges over an expansive area, extending from Icy Cape and Point Hope in the Chukchi Sea eastward to Cape Bathurst, Northwest Territories, Canada, and seaward at least 185 miles from the coast (Amstrup 2000, 2002; Bethke et al. 1996; Brower et al. 2002; Schliebe et al. 2006). The program area is within the core activity area of the SBS stock, from Herschel Island, Yukon, to Point Barrow, Alaska, and seaward about 85 miles (Amstrup 2000). The most recent population estimate for this stock is 907 bears (95 percent CI = 606−1,212) (Bromaghin et al. 2015).

The USFWS listed the polar bear as a threatened species under the ESA in May 2008 (73 FR 28212). The ESA listing decision was based on the rapidly diminishing sea-ice cover and thickness in the Arctic Ocean due to climate change (73 FR 28212; Durner et al. 2009). The continuing loss of sea ice was judged to put polar bears at risk of becoming endangered throughout their range in the foreseeable future. Subsequent modeling analyses predicted that declining sea ice cover may result in significant declines in polar bear populations within three generations (35–41 years; Regehr et al. 2016). Considerable research has focused on changes in population status and survival because of diminishing sea ice habitat. Regehr et al. (2010) documented decreases in vital rates of the SBS stock, including survival and breeding rates, corresponding to increases in the number of ice-free days per year in waters over the Beaufort Sea continental shelf (including waters adjoining the program area).

Polar bear harvest is legal for Alaska Natives under the MMPA. Polar bear harvest in the Chukchi Sea is managed by the U.S.–Russia Polar Bear Commission; the current harvest limit is 58 bears per year, of which no more than 19 will be females (82 FR 17446). For the 5-year period from 2010 to 2014, an average of 29 bears per year were removed from the U.S. portion of the CBS stock (PBSG 2019). Polar bear harvests in the SBS are managed through the Inuvialuit–Iñupiat Agreement, a voluntary Native-to-Native agreement between the U.S. and Canada (Nageak et al. 1991). For the 10-year period from 2006 through 2015, an average of 19 bears per year were removed from the U.S. portion of the SBS stock, averaging 50 percent males, 27 percent females, and 22 percent unreported sex (USFWS 2017).

Polar bears are large, long-lived (29–32 years), opportunistic hunters that feed primarily on ringed and bearded seals but also on beached carcasses of marine mammals (whales and walruses; Amstrup 2003, Schliebe et al. 2006, Miller et al. 2006). Mating occurs from March to late May. Adult males and non-pregnant females are active all year, but pregnant females construct and enter snowdrift natal dens in October or November (Amstrup and Gardner 1994) and give birth in late December or early January. Mothers and cubs emerge from natal dens in late March or April, when the cubs are 3–4 months old (Lentfer and Hensel 1980; Amstrup and Gardner 1994; Smith et al. 2007). The cubs remain near the dens for up to 2 weeks (Smith et al. 2007) as they adapt to outside temperatures. Cubs usually stay with their mothers until they are 1.5 to 2.5 years old (Stirling et al. 1975). Females breed again at about the same time they separate from their young, resulting in a breeding interval of females that successfully wean cubs of 3 years or longer.

Polar bears typically use land only during late summer, autumn, and the maternal denning season in winter; besides denning females, adult females with and without cubs, subadults, and adult males may all come ashore. Polar bears begin to appear on the mainland and barrier islands in July and August, during the open-water period (Miller et al. 2006, Schliebe et al. 2008). As seasonal and pack ice cover spreads southward in the late fall and winter, polar bears move with it, appearing along the Chukchi and Beaufort sea coasts (Amstrup 2000, Rode et al. 2015), although some may remain on pack ice all year, if there is continuous access to prey (Stirling 2009).

Peak numbers of polar bears observed on land generally occur in late September and early October (USFWS 1995; Schliebe et al. 2001, 2008; Kalxdorff et al. 2002). Bear numbers onshore have increased in autumn in certain locations, with the greatest concentrations occurring at Barter Island, Cross Island, and Point Barrow, where bears feed on bone piles of butchered bowhead whales taken during the autumn subsistence hunt (Miller et al. 2006, Schliebe et al. 2008, Atwood et al. 2016, Lillie 2018). The number of polar bears onshore is related to sea ice dynamics, although the distribution of bears onshore was most strongly influenced by the availability of food from subsistence whaling (Wilson et al. 2017).

The USFWS designated critical habitat for polar bears in Alaska in 2011 (75 FR 76086). Three units of critical habitat (all of which occur in the program area; **Appendix A, Map 3-25**) were designated, corresponding to the following primary constituent elements of critical habitat described in the final rule:

- Sea-ice habitat, used for feeding, breeding, denning, and movements, in U.S. territorial waters;
- Terrestrial denning habitat, on land along the northern coast of Alaska, with characteristics suitable for capturing and retaining snow drifts of sufficient depth to sustain maternal dens through winter, occurring within 20 miles of the coast between the U.S.–Canada border on the east and the Shaviovik and Kavik rivers on the west (including the program area), and within 5 miles of the coast from the Shaviovik and Kavik rivers west to Point Barrow;
- Barrier island habitat, used for denning, refuge from human disturbance, and movements along the coast for access to denning and feeding habitats, comprising barrier islands and associated mainland spits, along with the water, ice, and terrestrial habitat within 1 mile of those features, designated as a no-disturbance zone.

Critical habitat excludes human-made structures and the land on which they are located, as well as seven specific areas consisting of the communities of Utqiaġvik and Kaktovik and five U.S. Air Force radar sites (Point Barrow, Point Lonely, Oliktok Point, Bullen Point, and Barter Island).

Preferred habitats are in the active seasonal ice zone that overlies the continental shelf and associated islands and in areas of heavy offshore pack ice (Stirling 1988; Durner et al. 2004, 2009). Adult males usually remain there, rarely coming ashore (Amstrup and DeMaster 1988). Habitat use changes seasonally with the formation, advance, movement, retreat, and melt of sea ice (Amstrup 2000; Ferguson et al. 2000; Durner et al. 2004, 2009; Schliebe et al. 2008). During winter and spring, polar bears tend to concentrate in areas of ice with pressure ridges, at floe edges, and on drifting seasonal ice at least 8 inches thick (Stirling et al. 1975; Schliebe et al. 2006); the greatest densities occur in the latter two categories, presumably because those habitats provide more access to seals. Use of shallow water is greatest in winter, in areas of active ice with shear zones and leads (Durner et al. 2004). Polar bears spend more time on landfast ice in the spring when ringed seals have their pups. Multiyear ice is selected in late summer and early autumn as the pack ice retreats to its minimal extent (Ferguson et al. 2000; Durner et al. 2004).

Both CBS and SBS bears may den either on pack ice or on land. Most denning for the CBS stock occurs on Wrangel and Herald islands, along the Chukotka coast, and occasionally on sea ice. It is uncommon for CBS bears to use land in Alaska for resting or denning (Belikov and Boltunov 1998). Trends indicate that terrestrial denning is becoming more common for the SBS stock in Alaska. In the 1990s, 53 percent of the dens used by SBS bears were on pack ice, while 38 percent were on land (Amstrup and Gardner 1994). Recent data indicate the number denning on sea ice declined from 62 percent in the late 1980s 1985–1994) to 37 percent at the turn of the 21st century (1998–2004), an apparent shift to more terrestrial denning, possibly due to changes in features of pack ice that reduce its suitability as denning habitat (Fischbach et al. 2007).

The Beaufort Sea coastline, creek and river drainages, and bluffs along lakes in NPR-A provide the SBS bears important areas for resting, feeding, denning, and seasonal movements (**Appendix A, Map 3-25**). In northern Alaska, pregnant polar bears enter maternity dens by late November and emerge as late as April. Maternity dens are located in snowdrifts in coastal areas, on stable parts of the offshore pack ice, or on landfast ice (Amstrup and Gardner 1994). The USGS recently summarized known polar bear maternal dens locations in the Beaufort Sea and neighboring regions (Durner et al. 2010); the location of polar bear dens occurring in the vicinity of NPR-A are shown on (**Appendix A, Map 3-25**). Along the Alaska Chukchi Sea coast, denning occurs at Cape Lisburne, Cape Beaufort, the barrier islands between Point Lay and Peard Bay, the Kukpowruk, Kuk, and Sinaruruk rivers, Nokotlek Point, Point Belcher, Skull Cliff, and Wainwright Inlet (Durner et al. 2010).

Distribution patterns of polar bears are changing rapidly and are related to the increasing distance of pack ice from shore in the summer. Polar bears in the Chukchi Sea are increasingly using land habitats within their range (NMFS 2016a). A comparison of females radio-collared in 1986–1995 with those collared in 2008–2013 reported that the proportion of bears on land for more than seven days between August and October increased from 20 to 39 percent (Rode et al. 2015). Most of the CBS bears that used land in the summer and for denning went to Wrangel and Herald islands in Russia, a finding consistent with previous studies. The distribution of SBS bears has shifted north and west over the past 30 years as bears attempt to remain with the sea ice as long as possible (Derocher et al. 2013). SBS bears also are using land increasingly during the summer (Schleibe et al. 2008, Rogers et al. 2015, Atwood et al. 2016). Data from females radio-collared in the SBS between 1986 and 2014 showed an increase in the number of bears coming ashore, an earlier arrival on shore, increased residence time on shore, and later return to the sea ice (Atwood et al. 2016).

Pacific Walrus

Pacific walruses (*Odobenus rosmarus divergens*) occur throughout the continental shelves of the Bering and Chukchi seas, and occasionally in the East Siberian and Beaufort seas (USFWS 2014). Aerial surveys conducted in 2006 estimated 129,000 individuals (95 percent CI: 55,000–507,000) within the survey area (Speckman et al. 2011). This estimate is considered to be biased low because not all areas important to walruses were surveyed (USFWS 2014). They are protected under the MMPA and are listed as a Special Status Species by the BLM (BLM 2019). Walruses are an important subsistence resource in the Bering Straits region, where communities harvest 3,828–6,119 walruses per year.

During the winter breeding season, walruses occur in the Bering Sea in areas with thin ice, open leads, and polynyas (Fay et al. 1984, Garlich-Miller et al. 2011). Most of the population of Pacific walruses summers in the Chukchi Sea, although several thousand individuals, primarily adult males, congregate at coastal haulouts in the Gulf of Anadyr, Russia, both sides of the Bering Strait and Bristol Bay, Alaska. Historically, walruses spent the summer on sea ice cover in the Chukchi Sea, with large numbers found over Hanna Shoal in U.S. waters and near Wrangel Island in Russia (USFWS 2014). Over the past decade, the number of walruses hauling out on land along the Alaska and Chukotka coastlines of the Chukchi Sea has increased from hundreds to >100,000 (Kavry et al. 2008, Garlich-Miller et al. 2011, Jay et al. 2011). Within the NPR-A, walruses regularly haul out on the barrier islands of Kasegaluk Lagoon and coastline in and near Peard Bay (Jay et al. 2012, Fishbach et al. 2016) (**Appendix A, Map 3-18**). This change in distribution within the Chukchi Sea is coincident with the accelerating loss of summer sea ice over the continental shelf (NSIDC 2012). As more walruses haul out in coastal areas, they may deplete the prey resources that are readily accessible near the haulouts. Walruses rely primarily on bivalves as prey, but also eat a wide variety of other benthic prey items (Sheffield and Grebmeier 2009).

Walruses have an estimated auditory bandwidth of 100 Hz–50 kHz in water and 100 Hz–35 kHz in air (Finneran and Jenkins 2012). They produce a variety of sounds in and out of water in frequencies that range from 13 Hz to 4 kHz (Frankel 2009). Sounds can include roars, grunts, pulsed knocks, and bell-like or gong-like sounds.

Bearded Seal

The Pacific subspecies of bearded seal (*Erignathus barbatus nauticus*) is grouped into 2 distinct population segments: the Okhotsk distinct population segments that occurs in the Sea of Okhotsk, and the Beringia distinct population segments that ranges over the continental shelf waters of the Bering, Chukchi, Beaufort, and East Siberian seas. The Beringia distinct population segments is considered the Alaska stock of bearded seal. There is no reliable population estimate for the entire stock, but data collected in the U.S. portion of the Bering Sea were used to estimate an abundance of 299,174 (95 percent CI: 245,476–360,544) bearded seals in U.S. waters (Conn et al. 2014). This estimate does not include any bearded seals that were in the Chukchi and Beaufort seas at the time of the surveys (Muto et al. 2018).

Bearded seals are associated with offshore pack ice throughout the year, remaining close to the ice edge for as long as the ice is available. They use ice as a platform for breeding, pupping, molting, and resting. In summer, bearded seals may use nearshore areas of the Beaufort Sea (**Appendix A, Map 3-26**), and occasionally haul out on land (NMFS 2016a, Muto et al. 2018). The primary conservation concern for this species is the ongoing and projected loss of sea ice cover (Cameron et al. 2010), which led to their listing as threatened under the ESA in 2012. They are an important species for subsistence and cultural practices in villages within the NSB.

Bearded seals are widely distributed in waters adjacent to the NPR-A during summer, primarily along the southern edge of pack ice that is broken and drifting and provides leads, fractures, and polynyas (Burns and Frost 1979, Cameron et al. 2010). Acoustic and visual detections were concentrated between Wainwright and Utqiaġvik (Hannay et al. 2013; Clarke et al. 2013, 2015) from June to November, with additional visual detections recorded throughout the northeastern Chukchi and western Beaufort seas. Most bearded seals migrate south into the Bering Sea with the advancing ice in the fall and winter. Pregnant females generally overwinter on drifting ice in the Bering Sea and in coastal leads of the southern Chukchi Sea where they give birth to and wean their pups (NMFS 2016) before heading north again in the spring. Acoustic and telemetry data indicate, however, that bearded seals are also present as far north as Utqiaġvik year-round (Hannay et al. 2013, Quakenbush and Crawford 2019).

Male bearded seals vocalize during the breeding season, producing sounds between 3 and 6 kHz and can propagate up to 30 km (Cameron et al. 2010). Their estimated auditory bandwidth is 75 Hz–75 kHz in water and 75 Hz–30 kHz in air (Southall et al. 2007).

Ringed Seal

Ringed seals (*Pusa hispida*) have a circumpolar distribution and have five recognized subspecies (Kelly et al. 2010). The Alaska stock consists of a portion of the subspecies *P. h. hispida* that occurs within the U.S. waters of the Beaufort, Chukchi, and Bering seas (Muto et al. 2018). There is no reliable population estimate for the entire Alaska stock. Surveys conducted 1996–1999 yielded a conservative estimate of at least 300,000 ringed seals in the Alaskan Beaufort and Chukchi seas (Bengtson et al. 2005, Frost et al. 2004, Kelly et al. 2010). In 2010 and 2013, surveys estimated 170,000 ringed seals in the U.S. sector of the Bering Sea (Conn et al. 2014).

Ringed seals are year-round residents in the Beaufort and Chukchi seas (Muto et al. 2018). They use sea ice as a platform for pupping in the winter and early spring, molting in early summer, and resting throughout the year (Kelly et al. 1988). Ringed seals can be found in the nearshore areas during the summer and winter (Williams et al. 2002). Optimal wintering areas for ringed seals in the Beaufort Sea generally occur in waters 32–115 feet deep; however, subnivean seal structures have been found in waters depths of 5–10 feet in the central Beaufort Sea (Williams et al. 2006) and within one km of the coast; reaching densities of 0.5–1.2 seals/km^2 in the Beaufort Sea (Frost et al. 2002) and 1.6–1.9 seals/km^2 in the Chukchi Sea (Bengtson et al. 2005). Area-specific densities of ringed seals in the program area may depend on ice conditions, food availability, water depth, and human disturbance but survey data indicate that ringed seals consistently use portions of program area to establish lairs that provide protection from predators and thermoregulatory protection for newborn pups (Stirling and Smith 2004).

The decline in extent and duration of sea ice cover is the primary conservation concern leading to the listing of ringed seals as threatened under the ESA in 2012. During the summer, ringed seals forage along ice edges offshore and in productive open water (Harwood et al. 2015), including waters within 5 NM of the program area (**Appendix A, Map 3-26**). The population trends and status of this stock are currently unknown (Muto et al. 2018), but there are indications that ocean conditions recently have been favorable for ringed seals: ringed seals near Kaktovik are growing and maturing faster and at a younger age now than 30 years ago (Quakenbush et al. 2011). Ringed seals are harvested for subsistence primarily in spring, but also opportunistically in summer and fall (see Subsistence section).

Ringed seals have an estimated auditory bandwidth of 75 Hz–75 kHz in water and 75 Hz–30 kHz in air (Southall et al. 2007), although there is evidence that their auditory bandwidth may extend up to 100 kHz

(NMFS 2016). They produce 6 underwater calls in frequencies that range from 150 Hz to 6 kHz (Frankel 2009).

Steller Sea Lion

Steller sea lions (*Eumetopias jubatus*) range from California to Japan, with core concentrations in the Gulf of Alaska and the Aleutian Islands (Muto et al. 2018). Of the 2 stocks recognized in Alaska waters, only the Western stock that includes animals born at and west of Cape Suckling are likely to be encountered along the marine transit route. The most recent abundance estimate for the U.S. portion of the western stock is 53,303 individuals based on surveys conducted at haulouts in 2015 and 2016 (Sweeney et al. 2016), and is not corrected for animals that were seen at sea (Muto et al. 2018). The Western stock was first listed as threatened in 1990 and then endangered in 1997 under the ESA because of a steep decline in abundance from the 1970s to the early 2000s. The negative trends have reversed in the Gulf of Alaska and eastern Bering Sea east of Samalga Pass but continue in the Aleutian Islands (Muto et al. 2018). Factors slowing the recovery of the Western stock of Steller sea lions include competitive effects of fishing, predation by killer whales, illegal and legal shooting, incidental take by fisheries, disease, contaminants, and environmental change (Atkinson et al. 2008, NMFS 2008). Critical habitat is designated in Alaska and includes rookeries, haulouts, and foraging areas along the Aleutian Islands chain and around islands in the Bering Sea (50 CFR 226.202; **Appendix A, Map 3-23**).

Northern Sea Otter

Of the three stocks of sea otters (*Enhydra lutris*) that occur in Alaska, only the Southwestern distinct population segments that occurs from the Alaska Peninsula and Kodiak Island to the Aleutian Islands and Bristol Bay is likely to be encountered along the marine transit route. The most recent abundance estimate for this stock is 54,771 otters (Muto et al. 2018). The Southwestern stock has declined by 55–65 percent since the mid-1980s and was listed as threatened under the ESA in 2005 (70 FR 46366). There are five units of critical habitat designated in the Aleutian Islands, Alaska Peninsula, and Kodiak Island totaling 5,855 square miles (50 CFR Part 17; **Appendix A, Map 3-23**).

Bowhead Whale

Bowhead whales (*Balaena mysticetus*) are classified as endangered under the ESA and as depleted under the MMPA, but no critical habitat has been designated for this species. Of the four stocks recognized worldwide by the International Whaling Commission (IWC 2010), only the Western Arctic or Bering-Chukchi-Beaufort stock occurs in U.S. waters (Muto et al. 2018) and within the program area. Systematic counts of this stock have been conducted from the ice near Utqiaġvik since 1978, using both visual and acoustic monitoring methods. The most recent abundance estimate is 16,820 (CV = 0.052) whales (Muto et al. 2018) with a mean annual rate of increase of 3.7 percent (95 percent CI: 2.9–4.6 percent) calculated from 1978 to 2011 (Givens et al. 2016).

Bowhead whales remain in close association with pack ice and use shelf waters for most of the year (BLM 2012, NMFS 2016, Citta et al. 2018). They spend winters in the Bering Sea and migrate annually through the Chukchi Sea in spring to summer in the Beaufort Sea (**Appendix A, Map 3-27**). Winter distributions are concentrated on the Bering Shelf north of Navarin Canyon (Citta et al. 2012). In spring, whales follow leads in the sea ice through Bering Strait and northward within 40 km of the eastern Chukchi coast (Quakenbush et al. 2012). After passing Point Barrow, they continue eastward through the Beaufort Sea to Amundsen Gulf following leads that are farther offshore than in the Chukchi Sea. Spring migration is segregated by size and sex, with the smaller subadults migrating first, followed by larger whales, and finally cows with calves (Noongwook et al. 2007). Most whales transit through the Chukchi Sea in April and pass Utqiaġvik by early May.

The Western Arctic stock of bowhead whales spends the summer in a broad area from Amundsen Gulf and the eastern Beaufort Sea to the eastern East Siberian Sea. Aerial surveys conducted during summers 2006–2014 indicated that whales are distributed a mean 23.6 km (14.7 mi) from shore with annual median distances as close as 6.3 km (3.9 mi) in 2009 to 37.6 km (23.4 mi) in 2013 (Clarke et al. 2015). The largest numbers of whales were recorded in the central Beaufort Sea and east of Point Barrow. This is consistent with tracks from satellite-tagged whales that concentrated in 3 areas in summer: shelf waters of the Canadian Beaufort; shelf waters adjacent to Utqiaġvik; and the northern coast of Chukotka from Vankarem to Bering Strait (Citta et al. 2018).

Bowhead whales migrate west and south from their summering grounds beginning in late August. The extent of sea ice may affect the route, timing, or duration of the fall migration. They tend to travel closer to shore during westward migration in light and moderate ice years (median distance to shore 18–25 miles) than in heavy ice years (median distance to shore 35–45 miles) (Miller et al 1996, Moore et al. 2000). Tracks of tagged whales and visual observations indicate that bowheads occur in the northeastern Chukchi Sea from mid-September through October. Tagged whales pass Point Barrow heading west and south between 21 July and 2 November, with a median date of 10 October (Quakenbush et al. 2012). Most whales migrate westward thought the Chukchi Sea to Chukotka between 71 °N and 74 °N latitude, although some migrate down the Alaska coast (Quakenbush et al 2010).

Bowhead whales are filter feeders that rely primarily on zooplankton, especially euphausiids and copepods (Lowry et al. 2004, Moore et al. 2010). They feed in both the wintering and summering grounds and opportunistically while migrating (Schell et al. 1987, Budge et al. 2008, Moore et al. 2010). One of the most important feeding hotspots forms in the nearshore area east-southeast of Utqiaġvik in late summer and early fall (Ashjian et al. 2010, Moore et al. 2010, Okkonen et al. 2011). The physical forces of winds and upwellings concentrate prey and feeding activity within a few miles of shore and within the NPR-A project area (**Appendix A, Map 3-27**).

Bowhead whales are one of the most important species for subsistence and cultural practices for communities from St. Lawrence Island to Kaktovik. Much of the knowledge about whale behavior and population trends has been documented first by hunters and members of whaling crews.

Bowhead whales have an estimated auditory bandwidth of 7 Hz–22 kHz (Southall et al. 2007). Inferring from their vocalizations, bowhead whales should be most sensitive to frequencies between 20 Hz and 5 kHz, with maximum sensitivity between 100 and 500 Hz (Erbe 2002). Subsistence hunters note that bowhead whales are sensitive to noise during the spring whaling season (Noongwook et al. 2007).

Other Whales

Subarctic whales listed under the ESA that occur along the vessel transit route include blue, fin, humpback, North Pacific right, and sperm whales. The species of primary concern is the North Pacific right whale because it is considered the rarest of all large whale species and among the rarest of all marine mammal species worldwide. The most recent population estimate is 31 whales (Muto et al. 2018). Critical habitat was designated for the eastern North Pacific right whale in 2008 (73 FR 19000) in the Bering Sea along the marine transportation route, based on geographic coordinates where they have been consistently sighted in spring and summer (**Appendix A, Map 3-23**). Blue whales are present in Alaska waters only during their non-breeding season and could be found in the open waters near the Aleutian Islands, although most detections have occurred in the Gulf of Alaska (Stafford et al. 2003, Carretta et al. 2019). Fin whales are present in both the Bering and Chukchi Seas in the summer, with greater numbers in the Bering than the Chukchi Sea (Muto et al. 2018). Individual humpback whales from the Western North Pacific Stock could occur in the Bering Sea and possibly in parts of the Chukchi and Beaufort seas (Muto et al. 2018), although sightings are rare.

Climate Change

Climate change is a global issue affecting marine mammals in the program area (see Section 3.2.1) and is expected to be most dramatic in the Arctic, with rates of warming nearly twice that experienced globally (ACIA 2005, Wendler et al. 2014). The effects of these global trends are complicated, but forecasts point to dramatic declines in the extent and thickness of sea-ice cover in the Arctic. This loss of sea ice has serious implications for the future of ice-associated species such as polar bears, ice seals, and ice-associated whales (Durner et al. 2009, Cameron et al. 2010, Kelly et al. 2010, Regehr et al. 2016). Increased air and sea temperatures, longer periods of open water with an earlier onset of melting and later onset of freeze-up, increased rain-on-snow events, warm water intrusion, and changing atmospheric wind patterns are contributing to overall reduction and changes in sea ice (Kovacs et al. 2011, Chapin et al. 2014, Stroeve et al. 2014, Joint Secretariat 2015). Continued arctic warming and the resulting deterioration of sea ice pose a major threat to marine mammals and their prey in the Arctic.

Arctic sea ice is changing in geographic extent, thickness, age, and timing of melt, and change is occurring at rates higher than previously predicted. Long-term data sets show substantial decreases in the extent and thickness of sea ice cover during the past 30 years (Post et al. 2013, Wendler et al. 2014). These trends are projected to continue, possibly resulting in loss of summer sea ice by mid-century (Chapin et al. 2014, Stroeve et al. 2014) and deteriorating conditions in foraging and breeding habitats of all ice-dependent species. This affects hunters that rely on those species too:

> *The ice conditions; I noticed the ice isn't thick as it used to be 10 years ago, 15 years ago. Even last year, too, wasn't as thick as we'd like to see it. They're probably going further north just to find good hunting grounds because there's hardly any ice.* (Point Lay) (SRB&A 2014b)

In addition to changes in sea ice, ocean acidification is occurring as a consequence of increasing carbon dioxide in the atmosphere and is predicted to be amplified in the Arctic, resulting in changes in ecosystem processes and increased effects on organisms (AMAP 2013). Lower pH levels caused by increasing atmospheric carbon dioxide can interfere with invertebrate shell formation and the primary concern with ocean acidification is its effect on prey populations, particularly on benthic and free-swimming invertebrates that form shells. A decrease in ocean pH concurrent with increases in water temperature may interfere with calcification processes (Fabry et al. 2008, Kroeker et al. 2009, Hofmann et al. 2010), compromising the survival of invertebrates and reducing prey availability for marine mammals (Doney et al. 2012, 77 FR 76708).

The combination of ocean acidification and changes in sea ice present the greatest source for possible population-level impacts on marine mammals over the next 20–40 years, although the impacts are not entirely clear and may vary among species. Walruses already are exhibiting dramatic changes in distribution in response to sea ice reduction (Kavry et al. 2008, Jay et al. 2012). No information is available on the effects of ocean acidification on walrus prey species which makes it challenging to predict how resilient walruses may be to increasing ocean acidification (USFWS 2014). In contrast, bowhead whales appear to be in better body condition in years of light ice cover (George et al. 2015) and the Western Arctic stock appears to be adapting to change in ice cover, as demonstrated by their consistent population increase (Givens et al. 2013, Muto et al. 2018). The long-term effect, however, of reductions in sea ice on bowhead populations is not known (George et al. 2015).

Beluga whales may be sensitive to changes in arctic weather, sea surface temperatures, or ice extent, and the concomitant effect on prey availability. Arctic cod, a major prey item for belugas, are most prevalent at the 656- to 984-foot depth in the western Beaufort Sea—the depths to which most belugas dive (Hauser et al. 2015). Recent evidence for declining growth, body condition, and blubber thickness suggests that ecosystem changes may be affecting belugas through reduced availability or quality of prey, primarily ice-associated arctic cod (Harwood et al. 2014, 2015). Laidre et al. (2008) and Heide-Jørgensen (2010) concluded that belugas are probably less sensitive to climate change than other arctic cetaceans because of their wide distribution and flexible behaviors. If salmon or whitefish become more prevalent in the Beaufort Sea in the future, the diet composition of belugas could shift, but to what degree remains speculative at present. Thus, future effects of climate changes on belugas and their habitat could result in less, or more feeding opportunities, depending upon how the populations of prey species respond to the new environmental conditions. This in turn would affect the physical and behavioral state of belugas, as well as most population parameters. Losses in sea ice could allow marine predators, such as killer whales, to penetrate into the Beaufort Sea for longer distances, increasing the risks of predation on belugas (O'Corry-Crowe et al. 2016). Most belugas, however, prefer feeding in deep water near the shelf break, and are capable of diving to 2,950 feet in the Canadian Basin (Hauser et al. 2015), well beyond the maximum dive depth of 833 feet for killer whales (Miller et al. 2010).

Faster growth and maturation of ringed seals near Kaktovik over the last 30 years suggest that changing ocean conditions have been favorable for that species recently (Quakenbush et al. 2011). The broad distribution, diverse diet, and ability to haul out on land or ice suggest that ringed seals may be resilient to changes in sea ice availability (NMFS 2013), at least in the short term. The greatest impacts to ringed seals from climate change, however, would manifest in reductions of sea ice and less snow cover (77 FR 76708). Although winter precipitation is forecasted to increase in a warming Arctic (Walsh et al. 2012), the duration of ice cover could be reduced leading to lower snow accumulation on ice (Hezel et al. 2012), particularly over their subnivean lairs. According to climate model projections from NMFS, snow cover is expected to be inadequate for the formation and occupation of lairs within this century over the Alaska stock's entire range (Kelly et al. 2010).

Bearded seals are strongly associated with sea ice over shallow benthic habitat that is suitable for feeding, suggesting that they may be less resilient to reduced sea-ice cover (NMFS 2013). Reductions of sea ice in the Bering Sea may require that bearded seals shift their nursing, rearing, and molting areas to ice-covered seas north of the Bering Strait, where projections suggest a potential for the ice edge to retreat to deep waters of the Arctic basin. There is a moderate to high threat that reductions in spring and summer sea ice would result in spatial separation of sea ice resting areas from benthic feeding habitat (77 FR 76740, December 28, 2012). Such an event would force seals into suboptimal conditions and habitats, and likely compromise reproduction and survival. NMFS (Federal Register 2012) concluded that the Beringia distinct population segments of bearded seals is under no present threat from climate change, but future changes in sea ice could present an increasing threat leading to the extinction of the Beringia bearded seal distinct population segments by 2095.

Recent changes in demography, distribution, habitat use, and behavior of polar bears are attributable primarily to loss of sea-ice habitat as a result of climate warming (Atwood et al. 2016, Regehr et al. 2016).

The greatest future declines in optimal polar bear habitat are predicted to occur in the "Divergent Ice Ecoregion" along the Arctic coastlines of Russia and Alaska, where reductions in sea-ice habitat are predicted to reduce polar bear populations (Durner et al. 2009, Regehr et al. 2016). Based on population size, summer ice loss, length of ice-free period, amount of habitat over the continental shelf, and prey diversity, the SBS stock has been ranked as one of three stocks having the highest vulnerability to the effects of climate change (Hamilton and Derocher 2018). Recent historical analysis (1979–2014) of sea-ice conditions in the annual range of the SBS revealed trends of spring ice retreating 9 days earlier per decade and fall ice advancing 8.8 days later per decade, an increase of length in the ice-free season of 17.8 days per decade (Stern and Laidre 2016). That study also calculated a decrease of 9.3 days per decade in mean sea-ice concentration during June–October and a decrease of 17.5 days per decade in the number of days of ice cover. The decreased albedo from sea-ice loss (9 percent per decade during 1982–2011) has led to significantly increased absorption of solar radiation by ocean waters, especially along the Beaufort Sea coast of Alaska, from May through September, lengthening the open-water season and delaying autumn freeze-up (Stroeve et al. 2014).

Declining sea ice related to climate change has led to the following behavioral changes over the past two decades:

- Increased travel speed and time spent active, and thus energy expenditure, by collared female bears on sea ice (Durner et al. 2017);
- Increased frequency of long-distance swimming, and thus energy expenditure, by collared female bears, peaking during July–September (Durner et al. 2011, Pagano et al. 2012, Pilfold et al. 2017, Pngracz and Derocher 2017);
- Observations of swimming bears and dead bears in open water (Monnett and Gleason 2006, Schliebe et al. 2006);
- Increased percentage of the population coming ashore and spending more time on land, with arrival dates becoming earlier, at a rate of about 5 days per decade, and departure dates becoming later, at a rate of about 7 days per decade (Atwood et al. 2016b, Wilson et al. 2017);
- Higher activity levels while ashore (some of it associated with foraging on bowhead whale carcasses) and more time spent in marginal habitats (on land and on sea ice off the continental shelf) than in preferred habitat (sea ice over the continental shelf; Ware et al. 2017);
- Increased use of terrestrial habitats for maternal denning (Fischbach et al. 2007, Olson et al. 2017);
- Unusual predation behavior (Derocher et al. 2000, Brook and Richardson 2002, Stirling et al. 2008);
- Polar bear predation and cannibalism (Amstrup et al. 2006).

Polar bears of the SBS stock experienced twice as many days of reduced sea ice from 2008 to 2011 than did those of the Chukchi Sea stock. Despite similar diets, SBS bears were smaller, in poorer condition, and exhibited lower reproductive rates than bears of the Chukchi Sea stock, and twice as many were fasting in spring (Rode et al. 2014). The increased frequency of female SBS polar bears denning on land now rather than on pack ice has been attributed to reductions in stable old (multi-year) ice, increases in unconsolidated ice, and lengthening of the melt season (Fischbach et al. 2007, Olson et al. 2017).

Delays in the formation of seasonal sea-ice cover in the fall are forcing more bears to spend more time on land where they have difficulty catching prey. Bears spend longer periods fasting, and increasing the chance of human/bear interactions, which increases the risk of bears being killed in defense of life or property (Amstrup 2000, Species at Risk Committee 2012, Whiteman et al. 2015, Joint Secretariat 2015). Population-level effects of sea-ice loss have been observed in polar bears at the southern edge of their range in western Hudson Bay, and models predict decreased survival (including breeding rates and cub litter survival) of polar bears in the SBS population with reduced sea-ice coverage (Regehr et al. 2010, Hunter et al. 2010). Reduced body size, cub survival, and recruitment in polar bears have been documented in years when sea-ice availability was reduced (Rode et al. 2010).

Given the high metabolic demands and increased movements of polar bears, cascading negative effects on polar bear populations are predicted as sea ice declines and the availability of preferred, high-energy prey decreases accordingly (Rode et al. 2015, Pagano et al. 2018a, Whiteman 2018). Carcasses of large whales can provide fat- and protein-rich food sources for polar bears, enabling them to store large amounts of fat for long periods of fasting, but availability of whale carcasses is not likely to provide a sufficient food source to replace ice seals in polar bear diets as sea-ice continues to decline (Laidre et al. 2018). Although locomotion by polar bears on land is relatively efficient at the slow walking speeds they prefer (mean = 3.4 km/hour, or 2.1 mph, similar to grizzly bears), it becomes less efficient at unusual speeds above 5.4 km/hour (3.3 mph; Pagano et al. 2018b), potentially increasing energetic demands if polar bears are disturbed while spending time ashore.

The warming temperatures and increased precipitation year-round and longer growing seasons that are predicted to occur in the future may have negative implications for the stable conditions required for maternal denning by polar bears, especially if warm temperatures prevent snow cover of sufficient depth from accumulating early in the denning season. Recent research predicts that shorter annual periods of snow cover in the future are likely to result from increased air temperatures, later freeze-up in fall, and earlier snow melt in spring. Although snow cover in northeastern Alaska still is predicted to occur in the October–April time frame (Littell et al. 2018, Box et al. 2019), which covers the maternal denning period, snow depth is more difficult to predict.

Range expansion of subarctic and temperate species into the Beaufort and Chukchi seas has been observed in recent years and is likely to continue with changing arctic conditions. Increased observations of gray whales, humpback whales, and fin whales in the northeastern Chukchi Sea and of gray and humpback whales in the western Beaufort Sea are a relatively recent phenomenon (Clarke et al. 2015). Thus far, potential range expansion into the Beaufort Sea has been limited, but sightings appear to be increasing slowly. Range expansion by temperate species raises the possibility of resource competition with arctic species (ACIA 2005). Other risks to arctic marine mammals induced by climate change include increased risk of infection and disease with improved growing conditions for disease vectors and from contact with nonnative species, increased pollution through increased precipitation transporting river borne pollution northward and increased human activity through shipping and offshore development (ACIA 2005, Huntington 2009, Hauser et al. 2018).

Direct and Indirect Impacts

Analysis Assumptions

- Impacts to polar bears are directly related to the types of impacts to historical dens, amount of potential maternal denning habitat mapped, and likelihood of use by polar bears of the areas subject to various lease types and stipulations.
- Impacts to pinnipeds are directly related to the length of coastline available for coastal infrastructure development.

- Impacts to whales are related to the amount of industrial activity facilitated by coastal areas open for leasing, as this would influence the demand for commercial vessel transport, and thus the risk of injury and mortality to marine mammals from vessel strikes and hazardous material spills.
- Procedures required under the MMPA ITR authorization process and an ESA section 7 consultation for threatened and endangered species would be followed

The effects of authorized activities on marine mammals in the NPR-A were described in the final EIS for the existing IAP for NPR-A (BLM 2012). The Final EIS on Effects of Oil and Gas Activities in the Arctic (NMFS 2016a) provides additional descriptions of potential impacts of petroleum-related industrial activities on marine mammal populations, including seismic exploration and drilling activities. Those analyses are incorporated here by reference. Recent research indicates that the effects of climate change described under *Affected Environment* above are likely to influence the rate and degree of the potential direct and indirect impacts from program-related activities.

Impacts Common to All Alternatives

The following potential actions and environmental consequences would be common to all alternatives, although the extent of activities allowed and the areas affected would differ under each alternative, as described later in this section. All of the alternatives would affect large areas of the designated terrestrial-denning unit of critical habitat for polar bears; any facilities constructed within 5 miles of the Beaufort coast would be located in that critical habitat unit. All alternatives would also affect the marine environment along the shipping corridor from Dutch Harbor to the program area and pose three risks to marine mammals in these areas associated with vessel traffic: hazardous substance spills, disturbance from noise, and ship strikes.

Habitat Loss and Alteration

Very little open-water habitat is expected to be physically lost under any of the alternatives because barge landings, seawater treatment plants, and gravel islands are typically constructed in shallow waters on or close to shore. Open-water habitats used for migration and feeding may, however, experience a change in the soundscape (see **Section 3.2.3**, Acoustic Environment) that constitutes direct habitat loss (BOEM 2018). Vessel presence and noise have the potential to disturb and displace marine mammals from transit routes for short periods of time (i.e., minutes required for vessels to pass). Habitat alteration could occur from changes to water quality, such as from accidental spills or contamination. Any brine effluent discharged from seawater treatment plants would impact local marine water quality, chemistry, and temperature, potentially making conditions unsuitable for marine mammals.

Although polar bears use terrestrial habitats more extensively than any other marine mammal species, seals and walruses that occasionally haul out on land would also be affected by changes in terrestrial habitats along the coast. Direct loss or alteration of terrestrial habitat used by marine mammals would potentially result from overland travel, gravel mining, gravel and ice road construction, changes in natural drainage patterns (impoundment), off-pad snow disposal, and construction of coastal infrastructure (e.g., gravel islands, seawater treatment plants; **Appendix B, Section B.5**). Habitat loss and alteration is expected to occur when infrastructure is constructed and during all stages of oil and gas development following leasing. The direct effects of habitat loss will be specific to the sites that are constructed, but the indirect effects of displacement will extend to the local area as animals relocate to areas without infrastructure. The duration of effects will be for the lifetime of the infrastructure, which may be as little as a few months for temporary structures such as ice roads to over 20 years for gravel pads and roads.

Polar Bear

The permanent, direct loss of polar bear habitat as a result of oil and gas leasing-related activities would primarily involve the terrestrial-denning unit of critical habitat (**Appendix A, Map 3-25**), which constitutes 4 percent (945,000 acres) of the program area. The areas of sea ice (434,000 acres or 2 percent) and barrier island (16,000 acres or <1 percent) critical habitat units potentially affected by program-related activities are smaller. Even though the overall proportion of Barrier Island Critical Habitat in the program area is not large, it receives a disproportionately high level of use by polar bears (Wilson et al. 2017); thus, activities affecting that habitat could have a larger impact on polar bears than is indicated on the basis of proportional representation.

It is important to note that not all portions of the terrestrial-denning unit of critical habitat represent suitable maternal denning habitat. Specifically, potential maternal denning habitat (Durner et al. 2001, 2013; **Appendix A, Map 3-25**) covers an estimated total of 945,000 acres (assuming an average segment width of 21 feet; Durner et al. 2001) among the three development zones of estimated hydrocarbon potential, constituting the high-priority area that would need to be searched in den surveys before exploration or development activities occur (**Table 3-30**, Polar Bear Terrestrial Critical Habitat by Alternative, Lease Type, and Infrastructure Allowed), as required by ROP C-1. To date, the occurrence of maternal dens has been proportional to the occurrence of denning habitat in the respective development potential zones; of the 23 dens found, 10 of them (43 percent) occurred in the high development potential zone and 9 (39 percent) occurred in the medium development potential zone. In contrast, 4 dens (4 percent) occurred in the low development potential zone.

Table 3-30
Polar Bear Terrestrial Critical Habitat by Alternative, Lease Type, and Infrastructure Allowed

Type of Area	Alt A		Alt B		Alt C		Alt D	
	Acres	Percent	Acres	Percent	Acres	Percent	Acres	Percent
Mineral leasing	-	-	-	-	-	-	-	-
Closed to leasing	769,000	90	852,000	99	235,000	27	-	-
NSO	21,000	2	3,000	>1	515,000	60	449,000	52
Open	66,000	8	1,000	>1	105,000	12	407,000	47
Infrastructure	-	-	-	-	-	-	-	-
No infrastructure	225,000	28	756,000	92	188,000	23	6,000	1
Pipeline	14,000	2	57,000	7	59,000	7	84,000	10
Pipeline and roads	78,000	10	3,000	-	76,000	9	78,000	10
Coastal infrastructure	143,000	17	1,000	-	141,000	17	186,000	23
Available	358,000	44	1,000	-	354,000	43	464,000	57

Source: BLM GIS 2019

Temporary loss or alteration of polar bear denning habitat would result primarily from the construction of ice roads and pads, which persist for one winter season. The effects of ice placement in potential denning habitat would be temporary until the ice road or pad thawed during spring melt, although annual reconstruction in the same location would result in perennial loss of use of the specific bank-habitat segment affected. Because ice placement would not affect the topographic characteristics that create the favorable denning conditions, no long-term effects on habitat suitability would be expected. The existing Incidental Take Regulation (ITR)/Letters of Authorization (LOA) process requires that surveys for active dens be conducted within and near areas of operation prior to initiating activities during the denning season (November to April; 50 CFR 18.128). The use of airborne Forward-looking Infrared sensors has proven to be an effective means of locating dens in such surveys, as has the use of drone-mounted or handheld

Forward-looking Infrared sensors and specially trained dogs to locate or confirm dens in local areas (Amstrup et al. 2004b; York et al. 2004; Shideler 2015). Even so, these survey methods do not provide perfect detection and occupied maternal dens are sometimes missed in pre-operations surveys. Using airborne Forward-looking Infrared, the best available data indicate a range of detectability from 50 percent to 83 percent, depending on the experience of the crew, the number of surveys flown, the weather conditions prevailing at the time of the surveys (a rate of 22 percent was obtained by one crew due to complications with the helicopter, forward-looking infrared radiometry unit, and weather effects on the image), seasonal timing and snow depth (Amstrup et al. 2004; York et al. 2004; Shideler 2014). Therefore, it can be assumed that from 17 percent to 50 percent of maternal dens could be missed and bears subject to habitat loss and displacement (see Disturbance and Displacement below).

Polar bears moving through areas near industrial facilities may be disturbed by activities on, and some may be hazed away from, drill-site pads and other centers of human activity. Disturbance from traffic on access roads would likely alter the use of habitats by bears nearby, although those effects would diminish for facilities located farther inland because they would be less likely to be used by bears than areas at or near the coastline. Overall, the effects of reduced use of habitats near oil and gas facilities likely would be low, although they would be long-term in duration.

The potential effects of temporary habitat loss and alteration on polar bears are expected to be somewhat reduced by the mitigation measures described in ROP C-1, and the ITRs currently in place for the NPR-A (81 FR 52276). After the placement of gravel pads and roads during the construction phase, the attractiveness of some potential maternal denning habitat in the vicinity of infrastructure likely would be diminished for some bears because of the presence of the facilities and associated human activity.

Pinnipeds

Potential alteration of benthic foraging habitat could result from modification of the seafloor profile caused by dredging or screeding operations at a barge landing site, or construction of a gravel island (**Appendix B, Section B.5**). Barge landings are anticipated to occur annually, so this loss would occur throughout the 20-year analysis time frame, starting with the first permitted exploration and development project. The size of the affected area would be similar among the action alternatives, regardless of which possible landing site is used (Atigaru Point, Smith Bay, or Utqiaġvik). The exact amount of habitat to be altered would depend on the local bathymetry and the placement of the barge landing site or gravel island. Direct effects would be localized to dredged or screeded areas and potential indirect effects would likely be localized within the sediment plume.

Ringed seals could overwinter and produce pups in the nearshore program area (Kelly et al. 2010). Under all alternatives, the integrity of seal lairs would be threatened by collapse caused by tracked vehicles transiting sea ice during seismic activity or by the construction of winter roads on the ice without appropriate mitigation. In addition to physical alteration of potential habitats, tracked vehicles and ice roads in the nearshore environment could disturb and displace individual seals (see Disturbance and Displacement below) and could result in injury or mortality of pups and females (see Injury and Mortality below). The occurrence and schedule of seismic activities or ice roads in the nearshore environment is unknown, but much of the NPR-A has been covered by 2-D seismic surveying, and future 3-D seismic surveys are expected to be at the lease block level. Seismic exploration would occur in the early phases of any proposed project, whereas ice roads could occur during any phase of development. Starting with the first permitted development project, seismic and transportation impacts could occur semi-annually to annually, depending on the overall pace of development. Potential effects of habitat loss to on-ice traffic could be short-term within a season but occur in each winter and could occur throughout the nearshore environment of the program area.

Walruses occasionally haul out on land, and this behavior is becoming more common as sea ice availability declines in summer (Jay et al. 2012; USFWS 2014). Walruses tend to haul out on the Chukchi coast and barrier islands rather than coastal habitats east of Point Barrow (USFWS 2014); no haulouts currently are cataloged east of Point Barrow (Fischbach et al. 2016; **Appendix A, Map 3-24**). These terrestrial habitats would be avoided during program-related activities and thus are unlikely to be subject to alteration. Under all alternatives, the Chukchi coast of the NPR-A is designated for NSO and limited infrastructure development. The variation in acreage available for infrastructure development among alternatives is specified in **Appendix B**, **Tables B-1** through **B-4**.

Whales

No whale habitat is expected to be physically lost or altered under any of the action alternatives because barge landings and gravel islands are typically constructed in waters too shallow for use by whales. Vessel presence and noise have the potential to disturb and displace whales from transit routes, causing temporary, short-term loss of use of habitat. Belugas and mysticetes, including bowhead whales, can show strong avoidance of moving vessels. Vessel transits between Dutch Harbor and the program area could encounter several species of cetaceans, including those found in the Beaufort Sea and from the Bering and Chukchi seas. Barge shipping currently occurs annually, although the number of vessels is low. The NMFS previously determined that the potential for adverse effects of vessel noise were unlikely for cetaceans in this transit route (BLM 2012, NMFS 2016; BOEM 2018).

Disturbance and Displacement

All alternatives would result in a similar level of potential disturbance and displacement of marine mammals in the marine environment. Because vessel transit routes and the number of barge landing locations do not differ among the alternatives, neither would the potential effects of the activities associated with marine transport (facility noise, dredging or screeding, and transportation). Polar bears and seals would experience direct behavioral effects from disturbance caused by human activities and noise associated with ice road and barge transportation (vehicle passage and noise), dredging or screeding for marine barge docks and gravel island construction, human activities at camps, and oil spill response planning and drills.

During the seasons of open-water barge transport, large vessel traffic transiting from Dutch Harbor to the program area would have the potential to disturb or displace whales, seals, and possibly polar bears by the temporary disturbance of water and by creating strong low-frequency underwater sounds (Richardson et al. 1995). The potential for disturbance and displacement in terrestrial habitats will vary by alternative because the coastal areas available for essential infrastructure differ among alternatives. Sources of terrestrial disturbance and displacement include construction and operation of pipelines, roads, seawater treatment plant, and other community infrastructure. Terrestrial activities and facilities are not expected to have an effect on the behavior of whales, which do not generally approach within 1 mile of the coast.

Polar Bear

Noise and visual disturbance from human activity and operation of equipment, especially aircraft and vehicle traffic, have the potential to disturb polar bears nearby (Blix and Lentfer 1992; MacGillivray et al. 2003; Perham 2005; Schliebe et al. 2006; USFWS 2006b, 2008, 2009; Andersen and Aars 2008). The greatest concern is disturbance of maternal females during the winter denning period, which could result in premature den abandonment and reduced survival of cubs (Amstrup 1993; Linnell et al. 2000; Lunn et al.

2004; Durner et al. 2006). Polar bear dens are known to occur in the program area (**Appendix A, Map 3-25**), and the incidence of terrestrial denning by the SBS population along the Beaufort Sea coast is increasing (Fischbach et al. 2007; Olson et al. 2017), so the potential for disturbance of maternal dens during the exploration, development, and production phases of post-leasing oil and gas activities is of concern. Infrastructure will also be a source of disturbance for terrestrially denning bears, especially within 5 miles of the coastline.

Various studies have evaluated the effects of anthropogenic disturbance on polar bears. Amstrup (1993) reported that 10 of 12 denning polar bears tolerated exposure to a variety of disturbance stimuli near dens with no apparent change in productivity (survival of cubs). Two females denned successfully (produced young) on the south shore of a barrier island within 1.7 miles of an active oil processing facility and others denned successfully after a variety of human disturbances near their dens. Similarly, during winter 2000–2001, two females denned successfully within 1,320 feet and 2,640 feet of remediation activities being conducted on Flaxman Island (MacGillivray et al. 2003). In contrast, Amstrup (1993) found that several females responded to disturbance early in the denning period by moving to other sites, suggesting that females may be more likely to abandon dens in response to disturbance early in the denning period, rather than later. Initiating intensive human activities during the period when female polar bears seek den sites (October–November) would give them the opportunity to choose sites in less-disturbed locations (Amstrup 1993), at least in areas where oilfield activity occurs consistently throughout the year.

In undeveloped areas subject to seismic exploration or winter construction of exploration ice roads and pads during the post-leasing period, dens are likely to have been established and occupied by the time enough snow has accumulated to allow those activities to proceed, raising the risk of den disturbance and abandonment. In January or early February 1985, a collared female polar bear prematurely abandoned her den near the mouth of the Canning River in the ANWR, possibly in response to the passage of seismic exploration vehicles within 660–2,640 feet (200–800 m) of the den (Garner and Reynolds 1986). Premature abandonment has negative effects on population productivity: survival is poor for cubs that leave dens early in response to the movement of sea ice (Amstrup and Gardner 1994) and females that remain in dens through the end of the denning period have much higher cub survival rates than do females that emerge from dens early (Rode et al. 2018).

Experimental studies of noise and vibration in artificial (human-made) “dens” have been used to estimate the distances at which disturbance may occur. Blix and Lentfer (1992) reported that snow cover greatly diminished sounds and concluded that activities associated with oil and gas exploration and development, such as seismic surveys and helicopter overflights, would not be likely to disturb denning bears at distances greater than 330 feet (100 m) from dens. In a more rigorous study, however, MacGillivray et al. (2003) compared noise levels inside and outside of artificial dens at sites on Flaxman Island during a variety of industrial remediation activities, including passage by different vehicles and overflights by helicopters at various distances. Snow cover provided an effective buffer, reducing low-frequency noise by as much as 25 decibels and high-frequency noise by as much as 40 decibels for activities conducted near the artificial dens. The noise levels produced by various stimuli were detectable above background levels at ranges from 0.3 miles to 1.24 miles, however, depending on the stimulus. Low-frequency vibrations and noises were detected at the greatest distances. The most audible disturbance stimuli measured from inside the dens was an underground blast, detectable in artificial dens up to 0.8 miles from the source, and airborne helicopters directly overhead. Helicopters were detectable above background levels as far away as 0.6 miles, but the authors concluded that noises just above background are not likely to cause biologically significant responses (MacGillivray et al. 2003). Individual variability among bears in their tolerance to noise and disturbance, including hazing with acoustic deterrents, was an important factor in evaluating human disturbance.

Some female polar bears have denned successfully in the existing oilfields where industry activities occurred as near as 165–330 feet (50–100 m) from occupied dens, whereas other females abandoned dens where activities occurred at distances of 330–1,640 feet (100–500 m). In the final rule for the current Alaska Beaufort Sea ITRs (81 FR 52292), the USFWS stated that in 2006, 2009, 2010, and 2011, polar bears established dens prior to the onset of industry activity within 500 m (1,640 feet) or less of the den site, but remained in the den through the normal denning cycle and later left with cubs, apparently undisturbed despite the proximity of industrial activity.

The current Alaska Beaufort Sea ITR/LOA process requires that surveys of potential denning habitat be conducted within a 1-mile buffer zone surrounding the proposed locations of roads and pads (50 CFR 18.128), a mitigative measure that is expected to continue under subsequent ITRs. If dens are detected within a 1-mile buffer zone around the proposed locations of seismic exploration gridlines or ice roads and pads, then the activities would be moved outside of that radius to avoid dens, as required by ITR/LOA process, to reduce the effects on occupied dens to a negligible level of take. If dens are located after ice roads and pads are built, then traffic restrictions and emergency closures would be instituted. Such discoveries typically trigger emergency road restrictions and 24-hour monitoring until the bears depart the dens, as prescribed in typical polar bear interaction plans. If dens go undetected, however, then they are likely to be disturbed by exploration or production activities. Such disturbance would be short-term but widespread, with potentially grave consequences for the bears affected (see Injury and Mortality section below).

Blasting at gravel mines and pile-driving of bridge abutments during winter construction during the development phase of any project would be sources of noise in polar bear denning habitat. Pile-driving would occur at bridge crossings over rivers. Pile driving in or near water is known to produce strong underwater noise levels (e.g., Greene and Moore 1995; Blackwell et al. 2004) and, along with gravel blasting, would be one of the noisiest activities resulting from construction. The level of received sound at any specific distance from pile-driving depends on the water (or ice) depth in which the piles are driven, the density or resistance of the substrate, bottom topography and composition (e.g., mud, sand, rock), the physical properties and dimensions of the pile being driven, and the type of pile-driver that is used (Richardson et al. 1995; Blackwell et al. 2004). Winter blasting and pile-driving are likely to disturb some polar bears. Possible impacts on polar bears exposed to noise potentially include disruption of normal activities, displacement from foraging and denning habitats, displacement of maternal females and young cubs from dens, and reduced cub survival. USFWS-approved mitigation measures for avoidance and minimization of disturbance of dens, as required under the ITR/LOA process, would reduce the potential impacts of blasting and pile-driving on polar bears.

Displacement of non-denning bears from preferred coastal habitats would be another potential impact of disturbance by program-related activities in all program phases. In an experimental study on Svalbard, female bears with young cubs reacted to direct approaches by snowmachines an average of 1 mile away (mean distance = 5,033 feet; 95 percent CI = 1,667–9,081 feet; Andersen and Aars 2008). Medium-sized single bears (subadults) also reacted at fairly long distances (mean distance = 3,806 feet; 95 percent CI = 1,230–4,439 feet), and adult males and females without cubs were the least reactive (mean distances = 1,070 and 538 feet, and 95 percent CI = 453–1,627 and 161–1,781 feet, respectively). Besides reacting at longer distances, maternal females and subadults showed stronger responses than did adults without cubs.

Polar bears passing near infrastructure in the program area would be exposed to a wide variety of potentially disturbing stimuli resulting from seismic exploration; exploration and development drilling; pipeline, road, and pad construction and other human activity on pads; vehicles on pads and interconnecting access roads; barge traffic in the lagoon system and associated offloading operations at marine docks, gravel islands, seawater treatment plants; and spill-response drills (including equipment staging). A wide variety of behavioral responses by polar bears is likely to occur, ranging from avoidance by maternal females with young cubs in spring to approach by curious bears or those attracted by sights, sounds, and odors. Standard industry practice is to allow polar bears moving through areas of infrastructure to cross roads and pads without disturbance, reserving deterrence by hazing for situations in which bears endanger workers or attempt to linger on active pads or roads. The USFWS (2006b, 2008b, 2009; 81 FR 52276) has concluded that the types of activities typical of oil and gas exploration, development, and production projects in northern Alaska were not likely to have population-level effects on polar bear populations at the levels analyzed in developed areas in NPR-A. This conclusion was based on the fact that the behavioral responses of individual bears were short-term and localized.

Disturbance and localized displacement could occur during seasonal movements by polar bears in the program area. The net direction of movement by maternal females leaving terrestrial denning areas with young cubs is toward the coast, potentially requiring them to cross roads and pipelines during the development and production phases, although the number of such encounters likely would be small because maternal dens tend to be concentrated near the coast. The greatest likelihood for bears to encounter program-related infrastructure and activities is along the coast during the open-water season (mainly July–October), as bears move along the coast and congregate near the Utkiaġvik whale-bone pile in advance of the formation of seasonal ice. Facilities located directly at the coast such as the barge landings and seawater treatment plants would be most likely to be encountered by bears traveling along the coastline. Early detection of bears by trained bear monitors and detection systems would allow industrial activities to be modified to minimize disturbance of bears moving through the vicinity. The completion of barging in summer would reduce the potential for those activities to disturb bears moving along the shoreline, although some encounters are likely to occur in July and early August. Barge traffic operating in open water may cause short-term disturbance of bears swimming in the ocean.

Polar bears moving along the coast through established oilfields (Kuparuk, Greater Prudhoe Bay, and Point Thomson) routinely encounter human-made obstructions and are able to cross or move past them without difficulty, resulting in short-term disturbance rather than permanent movement barriers (USFWS 2008, 2009; 81 FR 52276). Short-term behavioral responses are not likely to have population-level effects and thus are considered less intense than are den disturbance and abandonment (USFWS 2008, 2009; 81 FR 52276).

Another source of potential disturbance of polar bears during all phases of exploration and potential development would be noise generated by industrial camps, such as seismic camps, and large facilities, such as central processing facilities and seawater treatment plants. Noise from production facilities would be relatively constant, with wind direction affecting the perception of sounds by polar bears. Depending on the individual bear, however, such stimuli could also be attractants.

Although short-term in duration, disturbance of denning female polar bears in the program area by 3D seismic exploration activities has the potential to cause moderate to major impacts by disturbing bears in dens that are not detected during pre-activity surveys; the ITR/LOA process governing post-leasing activities in the program area will be required to reduce those impacts to negligible levels. Judging from previous and ongoing activities in the NPR-A, the potential effects of short-term behavioral disturbance events on polar bears during the development and production phases of the program are likely to be negligible in magnitude under the ITR/LOA process.

The number of polar bears potentially affected by disturbance is likely to increase during the development and production phases in the future. Continuing declines in sea ice are expected to result in more polar bears being present onshore during the open-water period, traveling the coastline more in summer and fall, and denning onshore. Such increases are expected as a result of the current trends for increasing use of coastal habitats and terrestrial denning habitats (Fischbach et al. 2007; Schliebe et al. 2008; USFWS 2006b, 2008, 2009; Olson et al. 2017; Wilson et al. 2017). Polar bears spending more time on land as sea-ice cover diminishes are likely to experience an increase in fasting and negative effects on energy budgets as a result of reduced access to fat-rich prey (Molnár et al. 2010; Wilson et al. 2017; Pagano et al. 2018a; Whiteman 2018). It is likely that maternal denning will continue to increase in terrestrial habitats in the future, although the presence of operating facilities would probably discourage female bears from denning in suitable habitat nearby; instead, they would be more likely to seek suitable den sites in less-disturbed habitat away from facilities.

Pinnipeds

Potential noise and disturbance from program-related facilities and activities are likely to affect ringed, spotted, and bearded seals and walruses annually while they are in the program area. A primary source of potential disturbance is anthropogenic noise generated by aircraft flights, vessel traffic, and coastal facilities, such as a seawater treatment plant during the open-water season. Noise also could be generated by activities in the nearshore coastal or lagoon areas during the ice-covered season, such as seismic exploration, which could affect individual seals by exposing them to noise and lair disturbance. In-air noise generated by facilities would be relatively constant, with wind direction affecting the perception of sounds at haul-out locations and in lairs within a radius of 2.5–3.7 miles (Kelly et al. 1988). Additional noise could be generated by terrestrial construction, dredging or screeding and vessel traffic during barging operations in summer, ice roads in the nearshore environment and mobilization of modular units in winter, and oil-spill drills year-round.

Ringed seals are known to depart subnivean breathing holes and resting and birthing lairs in response to anthropogenic noise, including seismic surveys (Kelly et al. 1986). Radio-tagged ringed seals have departed lairs in response to snow machines at distances of 0.3 to 1.7 mi, seismic vibroseis on landfast ice at 0.4 mi, and human footfalls within 660 ft. Behavioral reactions of individual seals varied substantially, and some lairs remained in active use despite proximity to seismic survey lines, snow machine routes, and air traffic, whereas others were abandoned quickly in response to noise at greater distances. For example, seals did not leave resting lairs in response to helicopter flights at 1,500 ft above ground level or higher, but helicopters at 1,000 ft altitude caused just over 50 percent of seals to depart lairs. In an investigation of subnivean structures, the rate of abandonment was found to more than double with industrial noise associated with seismic surveys and island building (Kelly et al. 1988). Although ringed seals exhibited strong but variable reactions to anthropogenic noise, the displacement of seals from haulouts within 660 ft of seismic lines was determined unlikely to result in increased mortality, given that individuals maintain as many as 4 or 5 lairs each with little evidence that disturbance resulted in permanent abandonment. On-ice seismic activity has been found to displace seals from breathing holes and lairs, but the effects were limited to local areas and judged to be of little significance to the population at large (Kelly 1988). However, it is possible that some seals could be displaced from all of their lairs in an area, and permanent abandonment of birthing lairs would be harmful and possibly lethal to nursing pups. It is clear that seals are aware of sound intrusions and that they react at variable distances by temporarily departing lairs, but individual variation in reactions makes it difficult to define critical distances for noise disturbance (Kelly 1988).

Although marine mammals show overt reactions to noise from industrial activities, individuals or groups may become habituated if the noise does not result in physical injury, discomfort, or social stress (NRC 2003). Based on habituation reported for ringed seals at the Northstar Island facility (Blackwell et al. 2004), it is likely that at least some ringed seals may habituate to the noise and continue to use haul-outs and lairs for pupping near a seawater treatment plant location, but that cannot be predicted with confidence.

The occurrence and schedule of ice-supported seismic exploration and on-ice vehicle traffic are unknown, but disturbance of seals and walruses by such activities could occur annually throughout the 20-year time frame for this analysis. Since much of the NPR-A has been covered by 2-D seismic surveying, occurrence of seismic activity may be infrequent. Routes also are unknown, but the extent of such disturbance could be large, including most of the nearshore environment. The primary impact on seals and walruses would be temporary displacement and behavioral reactions. Local observations indicate that reductions in sea ice have affected haulout behavior, increasing the possibility of interactions in coastal areas:

> *Well, the seals have been coming onshore onto the land more frequently than previous years. I think it's because of our ice. It hasn't been there. Same thing with the walruses too. They've been onshore here for almost a month now. I think they go out and feed and then come back to shore because there's no ice for them. Yeah, I guess our northern ice cap has been melting so all the ice that does form over the winter is mostly first year ice which melts over the summer. That's been the case here the last few years with our walruses and seals. They come to shore here near town because there's no ice for them to rest on.* (Point Lay) (SRB&A 2013a)

Future vessel traffic is not expected to substantially disrupt normal pinniped behavioral patterns (breeding, feeding, sheltering, resting, and migrating) because most pinniped/vessel interactions documented during arctic oil and gas exploration operations display minor behavioral reactions to vessels (NMFS 2018). Pinnipeds typically show limited responses to vessel noise, such as increased alertness, diving, moving from the vessel's path by up to several hundred feet, or by ignoring the vessel. If hauled out, seals and walruses typically enter the water when approached by vessels. Exposure to vessels during the open-water period may affect individual seals and walruses, but evidence of habituation to activity and evasion of vessels indicates that activities associated with marine transport to the program area are not likely to affect the reproductive success or survival of seals and walruses. K-5 minimizes disturbance of seals and walruses by establishing rules of operation specifically in the vicinity of haulouts. The vessel noise and presence would be temporary and limited to affecting a few individuals by eliciting behavioral responses. Impacts at the population level for all pinnipeds are not expected. Any specific development plans that have the possibility of Level A or B take of seals or walruses would require an incidental take permit pursuant to the MMPA.

Whales

Baleen whales have a low-frequency hearing range of 7–35 kHz (NMFS 2016b). Toothed whales are a mid-frequency group with a hearing range of 150–160 kHz. The primary underwater noise associated with vessel operations is the continuous cavitation noise produced by the propellers on the oceanic tugboats, especially when pushing or towing a loaded barge (NMFS 2018). Oceanic tugboats have a source level of approximately 170 decibels at 3.3 feet that is anticipated to decline to 120 decibels re 1 micro Pascal rms within 1.15 mile of the source (Richardson et al. 1995). Generally, vessels do not produce sound source levels capable of injuring whales (Richardson et al. 1995; NMFS 2016a).

Whales often show tolerance to vessel activity; however, they may react at long distances if they are confined by ice or shallow water or were previously harassed by vessel operators (Richardson et al. 1995). Whale reactions to vessels may include behavioral responses, such as altered headings or avoidance (Blane and Jaakson 1994; Erbe and Farmer 2000); fast swimming; changes in vocalizations (Lesage et al. 1999; Scheifele et al. 2005); and changes in dive, surfacing, and respiration patterns. Beluga whale reactions to vessels depend on whale activities and experience, habitat, boat type, and boat behavior (Richardson et al. 1995). Aircraft flying at altitudes greater than 1,000 feet (303 meters) generally do not affect whales (Richardson and Malme 1993, Patenaude et al. 2002).

Future vessel and aircraft traffic associated with the program area activities could produce temporary avoidance of vessels, as well as changes in vocalizations, diving, swimming, and respiration patterns. None of these potential effects would be chronic or sufficient to produce meaningful energetic losses to individual whales or to their populations.

Injury and Mortality

Small numbers of accidental injury or mortality of marine mammals may occur under all alternatives. Maternal polar bears and cubs of the year would be susceptible to injury or mortality from 3D seismic exploration activities if the dens are not detected in pre-activity surveys, and polar bears crossing roads could be susceptible to vehicle strikes. Other marine mammals could be susceptible to vessel/equipment strikes during barging and in-water work. Additional injury or mortality of marine mammals may occur due to accidental spills or contamination. For polar bears, human/bear interactions are the program-related actions most likely to result in injury or mortality.

Polar bear

When the polar bear was listed as a threatened species in 2008 (73 FR 28212), the USFWS noted that the factors contributing to the primary threat identified in the listing analysis—rapidly diminishing sea-ice habitat—cannot realistically be regulated under their management purview; therefore, in lieu of influencing the causes underlying climate change, such as greenhouse gas emissions, the USFWS has focused on factors more amenable to regulation, such as habitat protection and the prevention and reduction of lethal take (USFWS 2016). The result of this approach is that even greater emphasis has been devoted to mitigation through interaction planning to avoid and minimize injury and mortality of polar bears (USFWS 2016).

Under all alternatives, future oil and gas activities would increase the level of human/bear interactions, creating the possibility for increased injuries or deaths of both bears and, to a much lesser extent, humans. No polar bear-related injuries to humans have occurred as a result of oil and gas industry activities. The most recent polar bear –caused injury occurred in 1993 at an arctic military radar site (81 FR 52276). As sea-ice cover continues to diminish, however, the number of encounters between humans and nutritionally stressed bears is expected to increase (DeBruyn et al. 2010), raising the likelihood of potentially dangerous encounters (Wilder et al. 2017).

Sightings of polar bears at industrial sites in the Beaufort Sea region of Alaska have increased in recent years, consistent with increasing use of coastal habitats as summer sea-ice cover has diminished (Schliebe et al. 2008; USFWS 2008b; 76 FR 47010; 81 FR 52276). The incidence of human/bear encounters and harassment by deterrence (hazing), however, remains relatively low. From 2010 through 2016, industry reported under ITR LOAs that 395 of 2,373 polar bears (16.6 percent) observed near industrial sites in the North Slope oilfields were disturbed either unintentionally (incidental take) or by intentional deterrence (Miller et al. 2018). The percentage of reported take by intentional deterrence decreased over time from a high of 39 percent of the bears observed in 2005 to 14 percent during 2010–2014 (81 FR 52276). The USFWS attributes the decrease in deterrence events to increased polar bear safety and awareness training of industry personnel, as well as ongoing deterrence education, training, and monitoring programs (76 FR 47010; 81 FR 52276).

Despite increased interactions in the existing oilfields in recent years, lethal take associated with oil and gas activities is rare. Three polar bears have been killed at oil and gas industrial sites in Alaska since the late 1960s: one in winter 1969, another in 1990 at the Stinson exploration site in western Camden Bay, north of the program area (Perham 2005; USFWS 2006b), and one bear in 2011 (killed accidentally during a hazing event) since the Chukchi Sea and Beaufort Sea ITRs went into effect in 1991 and 1993, respectively (USFWS 2008b, 2009; 81 FR 52276).

In addition to direct interaction with humans after being attracted to areas of human activity and direct interaction with humans, a second potential source of injury and mortality is premature den abandonment, which is a possible outcome of den disturbance and has been documented to have an adverse effect on cub survival (Amstrup and Gardner 1994; USFWS 2008b, 2009; 76 FR 47010; 81 FR 52276). Among program phases, this potential impact is of greatest concern with regard to 3D seismic exploration, which can occur across the entire program area, whether or not areas are open for leasing or surface occupancy. Therefore, although the activity would be short-term in duration, the impact would be widespread and the magnitude would be the same for all alternatives, posing the greatest potential risk of program-related demographic impacts on the SBS stock of polar bears. The pre-activity den detection surveys and related precautions against den disturbance in bear interaction plans, required under the ITR/LOA process, would reduce the likelihood of this potential risk, but would not eliminate it, because experience shows that not all occupied dens would be detected. Dens are not distributed evenly across the landscape, so the number of dens likely to be disturbed would be higher when seismic surveys are conducted in the high and medium hydrocarbon potential zones than in the low hydrocarbon potential zone (**Table 3-30**). While it is unlikely, it is also possible that one or more undetected dens could be run over directly by seismic vehicles, resulting in injury or death if the bears do not abandon the dens first.

A third potential source of injury or mortality is vehicle traffic on ice and gravel roads that intersect the movement paths taken by females with young moving from terrestrial denning habitat to hunting areas offshore in late winter (March–April), which poses a risk of vehicle strikes and disturbance-related distributional shifts. No vehicle strikes of polar bears along ice roads in the North Slope oilfields have been reported in agency documents evaluating impacts on polar bears, indicating the risk is very low and the impact is negligible thus far. Because of increasing use of terrestrial habitats by the SBS stock, the risk could increase in the future if development proceeds in the program area, resulting individual mortalities and long-term duration.

A fourth potential source of injury or mortality is accidental spills, leaks, and other sources of contamination. Polar bears are susceptible to thermal stress if their fur is fouled by direct contact with spilled petroleum products, which reduces body temperature and increases metabolic rate; oil is absorbed through skin contact, through the gastrointestinal tract, and by inhalation (Engelhardt 1983; Derocher and Stirling 1991). Contact and ingestion can lead to severe blood and kidney problems. The direct and indirect effects of spills depend primarily on the seasonal timing and location of the spills and on the volume of material released into the environment. Because of their more limited spatial extent, slower rates of dispersion, and higher likelihood of successful containment, terrestrial spills would have substantially less impact on polar bears than would spills in the marine environment during the open-water period in summer and fall. The only substantial potential program-related activity occurring in the marine environment would be annual barging of modules in several years during the open-water period, which would pose a risk of spilled fuel if a vessel carrying fuel were to run aground. To date, large oil spills in the marine environment from industry activities in the Beaufort Sea and coastal regions that would affect polar bears have not occurred, although the interest in, and the development of, offshore hydrocarbon reservoirs has increased the potential for such spills (81 FR 52276).

Small releases of contaminants also can have effects. Three polar bears have died near industrial sites in the past 40 years from chemical ingestion as a result of human activity (Amstrup et al. 1989; 81 FR 52275). Effective control of potentially toxic substances and careful attention to preventing spills of any size are key to preventing such injuries (BMP A-3, BMP and ROP A-4, A-5).

Pinnipeds and Whales

In winter, on-ice seismic activity and vehicle traffic, as outlined above, could destroy seal lairs, including birthing lairs, and could be lethal to a small number of adult seals and pups, although the probability of this occurring is low. Pups are particularly susceptible to mortality by crushing in the lairs or exposure if forced to abandon their birth lair before they have accumulated sufficient blubber. Seismic activity could occur along the entire coastline (depending on the alternative chosen and subject to ROPs) and throughout the 20 years of the plan.

In summer, vessel collisions may result in injury or mortality of whales or seals. The number and speed of ships is related directly to the severity of collisions between vessels and whales (Jensen and Silber 2004). In contrast, seals are less likely than whales to be struck due to their smaller size and higher maneuverability. Collisions with whales are rare for slow-moving vessels traveling at less than 10 knots (Laist et al. 2001; Vanderlaan et al. 2008). Barge convoys would move slowly, but the vessels would be unable to change direction or speed quickly.

The low incidence of propeller scars found on bowhead whales landed by Alaska Native whalers indicates that vessel strikes of bowhead whales are rare (Laist et al. 2001, George et al. 2017). Although it is possible that a marine mammal could be struck by a vessel engaged in the barging operation, such incidents are highly unlikely due to the slow vessel speed, nearshore transit routes, and low frequency of barge deliveries (assumed to be 1–2 landings per year). Previous analyses have concluded that there is no indication that vessel strikes are an important source of mortality for seals (NMFS 2013, 2016).

The absence of documented collisions involving industry vessels and marine mammals in the Bering, Chukchi, and Beaufort seas, despite decades of spatial and temporal overlap, suggests that collision probabilities are low along the transit route from Dutch Harbor to the program area (NMFS 2013). More specifically, it is unlikely that vessels would strike subarctic whales because: (1) few blue and sperm whales would be encountered, as they are found in deeper waters than those in which the transit route would occur, and are rare; (2) approximately 30 North Pacific right whales are known to exist; (3) few western North Pacific gray whales have been documented outside their feeding areas in waters around Sakhalin Island, Russia; and (4) vessel mitigation measures, such as reducing speed and avoiding designated critical habitat, are typically required by NMFS and reduce the likelihood of vessel strikes. Thus, ship strikes of marine mammals would be unlikely, but the potential to occur would still exist.

Another potential source of injury or mortality is accidental spills, leaks, and other sources of contamination. All of the exploration and development would occur on land, with oil being transported in terrestrial pipelines to the TAPS. The potential effects of accidental releases of hazardous materials (including oil spills) that reach the distributary channels of rivers and streams and adjacent marine waters would be minor to negligible due to the safeguards in place to avoid and minimize oil spills, provided that containment efforts are successful. In the unlikely event of a large oil spill reaching open water during summer or fall, bearded, ringed, and spotted seals and beluga whales could be negatively affected. The probability, volume, and potential spread of different types of spills are discussed in **Section 3.2.11**. Assuming that no large oils spills reach the open-water environment, potential impacts of terrestrial oil spills on marine mammals are expected to be minor to negligible.

Annual barging of modules during the open-water period would pose a risk of spilled fuel in marine environments if a vessel carrying fuel were to run aground. Additionally, small, accidental fuel spills could occur with refueling at sea. This potential impact would be common to all marine mammals. In previous analyses, the Bureau of Ocean Energy Management assumed a vessel transfer spill during offshore refueling to have an estimated volume range from <1 to 13 barrels (1 barrel equals 42 U.S. gallons). The 13 barrel maximum spill volume represents a spill where spill prevention measures fail, fuel lines rupture, and no oil remains on the vessel. A spill of less than 1 barrel could persist for up to 30 hours in open water, while a 13 barrel spill could persist for up to 2 days (Li et al. 2015).

Attraction to Human Activity and Facilities

Other than polar bears and walruses, marine mammals are not likely to be attracted to program-related activities or facilities. Polar bears are curious and opportunistic hunters, frequently approaching and investigating locations where human activity occurs (Stirling 1988; Truett 1993). Walruses occasionally approach coastal structures and vessels, possibly seeking a resting area or haulout. In 2007, a female and a subadult walrus were observed hauled-out on the Endicott Causeway (81 FR 52289). Proximity to humans poses risks of injury and mortality for both bears and humans and may necessitate nonlethal take through deterrence and hazing or, on rare occasions, lethal take to defend human life (Stenhouse et al. 1988; Truett 1993, Perham 2005). Walruses are at risk of injury but do not pose the same risk to humans that bears do.

Stirling (1988) reported that curious polar bears commonly approach offshore drilling rigs in the Beaufort Sea whenever sea ice moved into the area but did not remain nearby for long, unless seals were present in the leads created by the rigs. Similar behavior has been observed at Northstar Island, north of Prudhoe Bay. Sightings of polar bears at industrial sites in the Beaufort Sea region of Alaska have increased in recent years, consistent with increasing use of coastal habitats, as summer sea-ice cover has diminished (Schliebe et al. 2008; USFWS 2008b; 81 FR 52276), and this trend is likely to continue.

Encounters between polar bears and humans in the program area are most likely to occur on and near the coastline, as bears move through in late summer and fall (August–October) and as maternal females search for den locations in autumn and early winter (October–November) and depart from dens with dependent cubs in late winter (March–April); however, the latter animals are the least likely to be attracted to industrial facilities, due to their greater sensitivity to disturbance.

The current ITR/LOA process has proven to be effective at addressing and mitigating the risks of polar bear encounters with humans. Besides denning surveys, the interaction plan required by the ITRs, stipulates monitoring and reporting of bear sightings and encounters using trained observers, as well as training of personnel in nonlethal means of protection (deterrence and hazing).

Although camps and other activity areas have the potential to attract polar bears, experience demonstrates that these risks can be mitigated effectively by following the interaction plan (Truett 1993; Perham 2005; USFWS 2006b, 2008b, 2009). All program-related activities must be conducted to minimize the attractiveness of work and facility sites to polar bears and to prevent their access to food, garbage, rotting waste, and other potentially edible or harmful materials, as specified in ROP A-1, A-2, and A-8. Trained bear monitors would be on-site, and all polar bear sightings would be reported immediately to safety personnel.

Climate Change

The effects of climate change described under the *Affected Environment*, above, are part of the baseline conditions for marine mammals in the project area. See **Section 3.2.1** for a detailed discussion of the alternatives' contributions to global climate change.

Alternative A

The types of plan-related activities and facilities would be similar among the alternatives, but the location and extent of infrastructure and associated activity would differ, in accordance with lease stipulations and ROPs. The acreages of potential denning habitat available to maternal polar bears and coastal areas used as travel routes by polar bears and resting areas for pinnipeds differ among alternatives and are the best predictors of the differences in consequences for marine mammals among the alternatives. This evaluation assesses impacts by comparing the number of historical dens, amount of potential maternal denning habitat mapped, and likelihood of use by polar bears of the areas subject to various lease types and stipulations. For pinnipeds, impacts are assessed by comparing the length of coastline available for coastal infrastructure development. For whales, impacts would be related to the amount of industrial activity facilitated by coastal areas open for leasing, as this would influence the demand for commercial vessel transport, and thus the risk of injury and mortality to marine mammals from vessel strikes and hazardous material spills.

Under Alternative A, current management actions as approved in the NPR-A ROD (BLM 2013a) would be maintained, and effects on marine mammals would be as described above and in the final EIS for the existing IAP for NPR-A (BLM 2012). This alternative designates the Beaufort Coast (including 90 percent of the terrestrial denning unit of critical habitat for polar bears) as closed to leasing, although it does allow for development of coastal infrastructure in 72 percent (593,000 acres) of that area, with the exception of the mainland from Smith Bay to Harrison Bay (**Appendix A, Map 2-5**).

Alternative B

Habitat Loss and Alteration

Under this alternative, there would be less coastal habitat alteration than under Alternative A because nearly all of the coastline area (and consequently nearly all denning critical habitat) would be closed to fluid mineral leasing (**Appendix A, Map 2-6**); essential pipeline crossings (EPCs) would be limited to occurring from Icy Cape to Tangent Point and along two corridors through the Teshekpuk Special Use area (7 percent of denning critical habitat); and the Beaufort coastline would be unavailable for new infrastructure (**Appendix A, Map 2-6**).

Disturbance and Displacement

The probability of disturbing or displacing bears, seals, walruses, or whales would be lower compared to Alternative A because closing coastal areas to fluid mineral leasing would curtail any exploration or construction activities in these coastal areas that could lead to sources of disturbance.

Injury and Mortality

The probability of injury and mortality to marine mammals would be lower compared to Alternative A because the closure of leasing in coastal areas will preclude activities such as construction and establishment of camps that would lead to human-bear interactions and disruption of seal lairs or haulouts. The reduction in industrial activity would also reduce the demand for commercial vessel transport, thereby reducing the risk of injury and mortality to marine mammals from vessel strikes and hazardous material spills.

Alternative C

Habitat Loss and Alteration

Under this alternative, the amount of coastal habitat alteration would be similar to that under Alternative A despite the increase in acreage open to fluid mineral leasing (**Appendix A, Map 2-7**). The areas that are open for leasing compared to Alternative A are restricted to NSO that precludes building well pads or central processing facilities (**Table 3-30**). The other infrastructure development limitations are the same as those specified in Alternative A, with the exception of a pipeline corridor added on the western side of Harrison Bay (**Appendix A**, **Map 2-7**).

Disturbance and Displacement

The probability of disturbing or displacing bears, seals, walruses, or whales would be similar compared to Alternative A because the coastal areas available for infrastructure construction are similar or the same as Alternative A.

Injury and Mortality

The probability of injury and mortality to marine mammals would be similar compared to Alternative A because the coastal areas available for infrastructure construction are the same as Alternative A, leading to similar probabilities of human-bear interactions and seal lair encounters. Similar industrial activity would result in similar demand for commercial vessel transport, and no difference between alternatives A and C in the risk of injury and mortality to marine mammals from vessel strikes and hazardous material spills.

Alternative D

Habitat Loss and Alteration

Under this alternative, the amount of coastal habitat alteration would be greater than that under Alternative A because all of the coastline areas that include polar bear denning habitat would be open to fluid mineral leasing, subject to NSO (**Appendix A**, **Map 2-4**). Essential pipeline crossings and/or essential coastal infrastructure would be permitted along the entire coastline of the NPR-A under the BLM's surface authority, which includes 99 percent of polar bear denning habitat (**Appendix A, Map 2-8**).

Disturbance and Displacement

The probability of disturbing or displacing bears, seals, or whales would be higher compared to Alternative A because more of the coastline is available for infrastructure development than under Alternative A.

Injury and Mortality

The probability of injury and mortality to marine mammals would be higher compared to that under Alternative A because the allowance of infrastructure in coastal areas would allow for activities such as construction and establishment of camps that would lead to human-bear interactions. The increase in industrial activity would also increase the demand for commercial vessel transport, thereby increasing the risk of injury and mortality to marine mammals from vessel strikes and hazardous material spills.

Cumulative Impacts

Overall, the impacts of oil and gas exploration and development on marine mammals in the central Beaufort Sea, both within and east of the NPR-A, have been short-term with no population-level impacts on polar bears, seals, walruses, or whales. Most existing industrial development along the Beaufort Sea coast has occurred in terrestrial habitats, limiting the effects on marine mammals. Seals and walruses occasionally haul out on land, but typically not more than 1,000 ft inland. Polar bears use marine habitats offshore throughout the year much more than they do terrestrial habitats, but their use of terrestrial habitat may increase as sea ice cover decreases. Over time, however, development has expanded into marine areas, starting with the construction of West Dock in the Prudhoe Bay field. It was followed by the Endicott Project, which was the first offshore production facility in the region, and the Northstar Project, located on artificial islands offshore from Prudhoe Bay.

Offshore production facilities (Endicott, Northstar, Oooguruk, and Nikaitchuq islands) have recorded the highest incidences of polar bear sightings and nonlethal hazing incidents in the established oilfields in recent years, accounting for 47 percent of polar bear observations (182 of 390 sightings) from 2005 to 2008 (76 FR 47010; 81 FR 52276). Analysis of the cumulative effects of oil and gas leasing, exploration, development, and production by the National Research Council (NRC 2003) showed that "industrial activity in the marine waters of the Beaufort Sea has been limited and sporadic and likely has not caused serious cumulative effects on ringed seals or polar bears." Since the publication of that analysis, diminishing summer sea has resulted in the increased use of terrestrial habitat by polar bears (Schliebe et al. 2008, Rode 2015, Wilder et al. 2017). The expansion of oil and gas development along the arctic coast on both land and sea may reach a level at which the effects of industrial activity become problematic for polar bears in the future (Amstrup 2003a; USFWS 2009).

> *...there are other persistent organic pollutants that are concentrating in our animals. There are studies of the polar bears that are showing these concerns. These pollutions from industry developed elsewhere are coming to our lands with the way the air currents are and the precipitation, they are coming to our lands and we did not have to identify the issues, but we have to deal with it. This adds to what is coming from the fields of Prudhoe Bay, Alpine, and Kuparuk. There are changes to the animals which are our resources for survival, the fish, the caribou, the whale, and others.* (Nuiqsut) (BLM 2003b)

Existing oil and gas development, commercial transportation, subsistence harvest, changes in the activities of local communities, and management and research actions by federal and state agencies are the principal activities contributing to cumulative effects on polar bears and other marine mammals in Arctic Alaska. The combined effects of likely future actions, which for analysis purposes is anticipated to occur approximately 70 years after the ROD is signed, are in particular those located in the arctic marine environment, may contribute to adverse effects on polar bear, seal, walrus, and whale populations in the future, primarily through expansion of coastal and offshore development and the increased risk of a major marine oil spill.

Onshore and nearshore oil and gas production, such as those projects ongoing and proposed in the program area (such as GMT2 and Willow, see **Appendix B, Section B.3**), typically requires large sea lifts using barges to transport facility modules, equipment, and material from southern ports to docks or gravel islands on the Beaufort Sea coast. Holders of leases in the state waters of Smith and Harrison bays may propose building production islands that would be located within the analysis area, altering habitat and producing noise from pile driving. Nearshore and onshore infrastructure also can affect marine mammals through the need for sea ice roads that cross ringed seal habitat in landfast ice, and ice and gravel infrastructure can affect polar bear habitat and maternal polar bear denning, as described above. These impacts of production would likely affect polar bears through disturbance in coastal barrier-island and denning habitats, especially during construction, but would be mitigated through the ITR/LOA process overseen by the USFWS. Past responses of ringed seals to oil and gas activities have consisted primarily of minor behavioral reactions, with a few exceptions related to tracked vehicle activity in nearshore coastal areas. In 1998, a vehicle crushed a lair, killing one seal pup and injuring the female. In 2018, two separate vehicle events exposed seal lairs, causing the inhabitants to flee. The LOAs issued by NMFS would reduce the contribution of impacts of onshore infrastructure development outlined in the RFD to the past, ongoing, and future impacts.

Marine mammals are exposed to potentially toxic chemical compounds in the water and the food web that have been transported to the Arctic from around the world through the atmosphere, water currents, and migrating animals (AMAP 2010). As a top predator, polar bears tend to have higher levels of potentially toxic compounds that bioaccumulate in the food chain, such as organochlorines and mercury (Braune et al. 2005; AMAP 2010). At the time of listing under the ESA, however, contaminant levels in Alaska polar bears were considered relatively low compared to other stocks (USFWS 2017). Alaska stocks, including the SBS stock, continue to have some of the lowest concentrations of polychlorinated biphenyls, chlorinated pesticides, and flame retardants among all polar bear stocks (McKinney et al. 2011).

Considering all past, present, and RFFAs, by far the most significant factor affecting arctic marine mammals is ongoing climate change from greenhouse gas emissions and the resulting loss of sea-ice habitat. The effects of climate change will exert the primary influence on the degree and rate of cumulative impacts on polar bears and other marine mammals. The impacts of climate change, however, are not readily manageable or amenable to mitigation without sustained global action beyond the ability of resource management agencies. The risks to marine mammals associated with climate change are described under the *Affected Environment*, and these trends are projected to continue.

Under the current management structure, the outcomes of human/bear interactions and associated disturbance from human activities, including post-leasing oil and gas activities, have the next greatest potential impact on polar bears. Those impacts can be avoided or reduced through effective implementation of the ITR/LOA process and its attendant mitigation. Considering the effects of post-leasing oil and gas activities in conjunction with other human/bear interactions resulting from recreational, scientific research, and subsistence activities, the post-leasing effects of oil and gas activities in the program area would contribute additive incremental cumulative effects on polar bears by increasing human-bear interactions, with the significance of those effects depending on the successful implementation of effective mitigation and the action alternative selected.

For all marine mammals, noise generated by pile-driving, dredging, screeding, construction, facility operations, and vessel and aircraft traffic would cause disturbance and perhaps displacement, although the effect would be a short-term behavioral reaction. Operational measures that restrict the timing of vessel transportation and implementation of the incidental take authorization process will minimize the disturbance and displacement effects.

The impacts of the alternatives would add to past, present, and reasonably foreseeable impacts on marine mammals by contributing to habitat loss and alteration, disturbance and displacement, and injury or mortality. Although effective implementation of the incidental take authorization process and its attendant mitigation would render the cumulative contribution small, impacts from other RFFAs are increasing (e.g., coastal development, climate change). The relative magnitude of the cumulative impacts added from the alternatives would be greatest under Alternatives D (least protective, greatest incremental contribution), followed by Alternatives C and B (most protective, least incremental contribution). The effects of climate change described under *Affected Environment* above, however, could influence the rate or degree of the potential cumulative impacts in ways that are not yet clear.

3.4 SOCIAL SYSTEMS

The social systems section of the IAP/EIS describes and analyzes the social environment of communities within the NPR-A that may be affected by post-lease activities as a result of revisions to BLM leasing management policies. The subsistence, sociocultural systems, environmental justice, and economy sections use a three-tiered analysis method. Each community described under the broadest scope, Tier 3, has the potential to be affected by the leasing program while communities within the narrowest scope, Tier 1, are those most likely to be affected by the changes described in this IAP/EIS.

Tier 3 communities rely on two herds of caribou that changes to the BLM's management decisions may affect: the Western Arctic Herd and the Teshekpuk Caribou Herd. Tier 2 consists of peripheral communities that intermittently use the planning area along the southern portions of the NPR-A. These communities include Ambler, Kiana, Kobuk, Noatak, Noorvik, Selawik, and Shungnak. Tier 1 communities, the primary focus of the social systems analysis, are communities closest to the planning area whose residents rely heavily on resources within the region for subsistence. These communities are Anaktuvuk Pass, Atqasuk, Nuiqsut, Point Lay, Utqiaġvik, and Wainwright. A list of communities in all three Tiers can be found in **Appendix V Table V-1.**

Demographic information for communities analyzed in the social system sections is provided in various appendices. Potential impacts on communities in and near the NPR-A are primarily associated with subsistence uses. **Appendix T**, describes Iñupiat subsistence harvests, annual cycles of subsistence activities, and maps depicting each community's subsistence use areas by species type. To address the traditional social environment in the NPR-A, **Appendix U**, describes cultural, social, and political organizations and the history of traditional systems of communities in the NPR-A. The analysis is primarily focused on Tier 1 and Iñupiat communities. **Appendix V**, describes the need to address potential adverse health and environmental impacts on minority and low-income populations. The appendix provides race/ethnicity and income information for communities in all three Tiers. Management decisions affecting the BLM leasing program may affect the economic environment of communities in the NPR-A. **Appendix W,** provides tables describing the current economic characteristics of identified Tier 1 communities. Because changes to the BLM leasing program may lead to adverse health impacts with surrounding communities, **Appendix X,** describes population health statistics, food insecurity rates, and educational attainment levels for Tier 1 and Tier 2 communities. Finally, **Appendix E,** provides a formal evaluation of potential impacts and restrictions to subsistence uses from federal actions described within this IAP/EIS.

These appendices are written in support of the various social system resource sections and should not be used as sole sources of information. They are intended to provide supporting information to respective resource sections and better describe the communities in the NPR-A likely to be affected by changes to the BLM leasing program.

3.4.1 Landownership and Uses

Affected Environment

This section describes the general ownership and uses of lands in the NPR-A. Existing landownership in the planning area and other conditions related to land uses are described in the 2012 NPR-A Final IAP/EIS (BLM 2012, pp. 356-363). Updated information relevant to the planning area, where available, is described below.

Landownership

Landownership and jurisdictions are described in **Table 3-31**, below. The acreage reported in **Table 3-31** varies from the acreage reported in Table 3-21 in the 2012 NPR-A Final IAP/EIS (BLM 2012). Variation in landownership is in part due to the Natural Resources Management (NRM) Act of 2019, designation of the Peard Bay Special Area, and not including Colville River and Atqusuk lands in Native selection. Due to the NRM Act of 2019, more lands in the planning area are not administered by the BLM.

Table 3-31
Land, Mineral Ownership, and Administrative Jurisdictions

Ownership and Jurisdictions	Acres
Federally Managed in part or whole	22,754,000
Federal surface estate and federal subsurface estate	22,520,000
Native-selected	11,000
Nonfederal surface estate with federal subsurface estate	234,000
ANCSA corporation surface estate	202,000
Native allotments	29,000
State of Alaska surface	2,000
Lands without any federal jurisdiction	476,000
Total lands within the exterior NPR-A boundary	23,230,000

The NPR-A consists of 23.2 million acres, of which 22.8 million acres, or 97.8 percent of the NPR-A, are under BLM jurisdiction. Approximately 22.5 million acres are designated as BLM surface and BLM subsurface estate, while 234,000 acres are designated as non-BLM surface but BLM subsurface estate. All surface waters are under federal jurisdiction unless expressly conveyed.

Native allotments and village corporations in the planning area are described in the 2012 NPR-A Final IAP/EIS (BLM 2012, Section 3.4.1). Approximately 476,000 acres of Alaska Native lands are outside the BLM's jurisdiction. Of the 234,000 acres designated as non-BLM surface but BLM subsurface estate, approximately 202,000 acres of surface estate are designated as Alaska Native lands and 29,000 acres of surface estate are designated as Alaska Native allotments. Changes in acreage from the 2012 NPR-A Final IAP/EIS (BLM 2012) are due to the NRM Act of 2019.

The State of Alaska manages 2,000 acres of surface estate on BLM subsurface estate. The change from the 2012 NPR-A Final IAP/EIS (BLM 2012) is due to the inclusion of the Utqiaġvik airport.

Land Uses

The BLM manages land use proposals for winter activities that the BLM authorizes when winter conditions protect soils and vegetation in the planning area. Winter activities include oil and gas exploration, seismic exploration, overland movement, and research. The BLM reviews and approves these activities on a case-by-case basis with restrictions, as applicable. The general types of authorizations are described in the 2012 NPR-A Final IAP/EIS (BLM 2012, Section 3.4.1.2).

Rights-of-way (ROWs) have been issued throughout the NPR-A planning area. The ROWs described in the 2012 NPR-A Final IAP/EIS (BLM 2012) concerning communication and navigation authorizations, winter tundra travel by low-pressure vehicles, and oil and gas companies are the typical types of authorizations issued.

Overland access within BLM-managed lands in the NPR-A is limited due to the lack of permanent roadways. BLM-managed lands are accessed via aircraft during summer conditions or winter vehicles that meet the requirements of ROP C-2 during winter conditions. Access opportunities are described in **Section 3.4.10**, Transportation; authorized site locations are as described in the 2012 NPR-A Final IAP/EIS (BLM 2012, Section 3.4.10).

Climate Change

Some of the research being conducted within the planning area is for seismic and climatology-related research. The unique arctic conditions and remoteness of the NPR-A allow for uninterrupted data collection of data monitoring facilities. The USGS and the Department of the Interior jointly operate permafrost and climate-monitoring networks near Teshekpuk Lake to collect data on ecosystem responses to climate change in order to develop strategies to protect Department of the Interior trust species (USGS 2014; Love and Finn 2011). In Utqiaġvik, the Office of Air and Radiation and National Oceanic and Atmospheric Administration's Earth System Research Laboratory global monitoring division has operated an atmospheric baseline observatory measuring releases of carbon dioxide and methane from melting artic permafrost (NOAA 2015, 2019). The USGS also operates a unique observatory collecting data on geomagnetic variations in Utqiaġvik. The location of the facility near the Auroral Zone and Polar Cap can collect data unavailable at the other 13 ground-based facilities.

Climate change would not directly affect landownership patterns in the planning area; however, as most communities are located at or near sea level, any increase in mean sea level may decrease the amount of surface land owned. Climate change may affect the land uses and access opportunities in the planning area. The BLM primarily manages land use proposals during winter conditions, and climate change may increase the volatility of the seasonal condition.

Direct and Indirect Impacts

Potential impacts on landownership and uses are the result of decisions that change landownership or from lease stipulations that allow or restrict certain land uses. Landownership decisions, such as conveyance or transfers, can increase or decrease the amount of federal land and the type of management available for those lands. Use restrictions, such as those intended to protect resources or to reduce conflicts with other uses, can preclude the placement of new infrastructure or require special conditions for development. In areas subject to NSO, new land uses for oil and gas development would be precluded; however, community infrastructure could still be developed. Any new oil and gas uses would be required to locate in areas outside the NSO area. Depending on the use, developing the use outside the NSO area may not be physically or commercially viable. In areas subject to controlled surface use or timing limitations, additional requirements, such as long-term monitoring, special design features, and special siting requirements, could restrict a future oil and gas project's location or viability.

The effects of climate change described in the *Affected Environment*, above, could influence the rate or degree of the potential direct and indirect impacts. The effects of climate change described under the *Affected Environment*, above, are part of the baseline conditions for landownership and uses in the project area. See **Section 3.2.1** for a detailed discussion of the alternatives' contributions to global climate change.

Alternative A

Under Alternative A, the planning area would continue to be managed as described in the 2012 NPR-A Final IAP/EIS (BLM 2012). Approximately 11,763,000 acres would be available for lease sales, 67.3 percent of which (7,920,000 acres) would be available for surface use. NSO stipulations would be applied to 21.2 percent (2,492,000 acres) of lands available for leasing. Alternative A would close 48.3 percent of the planning area (10,991,000 acres) to fluid mineral leasing, primarily in the northeast and southwest portions of the NPR-A.

Alternative A would make 8,312,000 acres unavailable for new infrastructure, reducing the potential for impacts with land uses from the five phases of development. Closing the Teshekpuk Lake Special Area and the areas surrounding Utqiaġvik to fluid mineral leasing under Alternative A would maintain the integrity of research operations described in the *Affected Environment*. Subsistence uses in closed areas would continue unimpeded by oil and gas development activities (see **Section 3.4.3**, Subsistence Uses and Resources).

Under Alternative A, federal mineral estate under Native lands would be available for leasing; sand and gravel mining would be authorized on a case-by-case basis.

Impacts Common to All Action Alternatives

Under all action alternatives, areas within the planning area would be made available for lease sales. Impacts are analyzed through five phases of development, described as leasing, exploration, development, production, and abandonment and reclamation; they are driven by demand for petroleum resources. Demand for petroleum resources would result in the subsequent development of oil and gas exploration and production well pads, central processing facilities, roads, pipelines, barge docks, a seawater treatment plant, and other ancillary uses to support oil and gas development. The BLM would manage ROWs or easements across the NPR-A for access and construction of facilities on a case-by-case basis. Impacts from the five phases of development on land uses would vary under the action alternatives, as discussed below; the size, type, and amount would be nearly the same.

The five phases of oil and gas development, as described in **Appendix B**, **Section B.1**, in the program area may indirectly affect land uses in and surrounding the community of Nuiqsut. The RFD identifies low, medium, and high hydrocarbon potential areas within the planning area. The community of Nuiqsut lies within the high hydrocarbon potential region in the northeastern portion of the NPR-A. Noise, dust, and surface disturbance from oil and gas activities may affect the integrity of scientific operations near Teshekpuk Lake and Utqiaġvik by stressing the unique arctic and remote conditions of the NPR-A.

Potential impacts from the exploration phase of oil and gas development include land use conflicts from generated noise, dust, and road traffic associated with the use of existing roadways to access leased areas and the construction of temporary exploratory ice well pads. Impacts would be mitigated with mandated lease stipulations or ROPs, such as Lease Stipulation D-1, which requires exploration activities to use existing roadways.

Intensification of impacts from oil and gas-related activities would increase through the development and production phases. Construction activities would generate visual, noise, and user conflict impacts with land uses near prospected locations where new infrastructure would be allowed. Impacts from construction activities may be mitigated by NSO stipulations and ROP mandates that come into effect. Allowing for 61,000 acres of the planning area to be open for sand and gravel mining also would generate land use impacts, but to a lesser degree than fluid mineral activities.

Infrastructure construction and operation of facilities during the production phase may reduce the desirability of land use near leased areas, primarily from exposure to dust, air pollution, noise, helicopters, or road traffic generated from oil and gas activities. Under all action alternatives, long-term reclamation of land to its previous condition and use, or as the nearest affected community prefers, is required per Lease

Stipulation G-I. Impacts on land uses would occur from associated reclamation activities; however, the post-reclamation land use impacts from permanent infrastructure would be removed.

Potential impacts from the five phases of development within the program area may affect Native allotments and ANCSA corporation uses within the program area. Native allotments cover approximately 29,000 acres of the planning area, primarily concentrated near the coast and by rivers, and these allotments support subsistence activities and uses. Construction near Native allotments may reduce the desirability of using a specific area or allotment, primarily from exposure to dust, air pollution, noise, helicopters, or road traffic from activities; however, K-15 would minimize disturbance to Native subsistence hunters resulting from development and ensure access to Native allotments.

Under all alternatives, NSO stipulations that apply to rivers, coastal areas, and deep-water lakes are proposed.

Alternative B

The nature and types of impacts on land uses under Alternative B would be the same as those described under *Impacts Common to All Action Alternatives.* Making 11,420,000 acres available for lease sales and applying NSO stipulations to 33.2 percent of lands available for leasing would reduce opportunities for oil and gas-related land uses to be developed, when compared with Alternative A. NSO stipulations under Alternative B would preclude surface-disturbing activities along rivers and deep-water lakes (Lease Stipulations K-1 and K-2).

Compared with Alternative A, Alternative B would increase lands unavailable for new infrastructure to 10,537,000 acres, primarily along the Teshekpuk Lake and Utukok River Special Areas. Alternative B would authorize two pipeline right-of-way (ROW) corridors on 189,000 acres to transport resources from the high hydrocarbon potential zone without developing new roadway infrastructure. Pipeline development would be subject to further NEPA review. Land use conflicts from development would intensify during the construction phase with conflicts likely reducing during the production phase. The integrity of scientific research operations may be affected by noise, dust, and activity generated from pipeline and infrastructure development and operation.

Under Alternative B, there would be no leasing allowed on federal mineral estates under Native lands. The BLM would authorize sand and gravel mining on a case-by-case basis.

Alternative C

The nature and types of impacts on land uses under Alternative C would be as described under *Impacts Common to All Action Alternatives*. Compared with Alternative A, Alternative C would increase the lands available for leasing to 17,053,000 acres (approximately 74.9 percent of the planning area). Making only 5,013,000 acres subject to NSO stipulations would increase the locations where new uses could be developed to 11,418,000 acres (66.9 percent of lands available for leasing). Areas subject to timing limitations under K-9 would influence the future design, location, and extent of seasonal use in the Teshekpuk Caribou Habitat Area.

Compared with Alternative A, Alternative C would decrease the lands unavailable for new infrastructure development to 5,133,000 acres (approximately 22.6 percent of the planning area). With more lands available for infrastructure development, Alternative C would authorize a single pipeline corridor ROW in the Teshekpuk Lake Special Area. Impacts would be the same as those described under Alternative B, but to a lesser degree.

Native allotments under this alternative would be the same as under Alternative B. Federal mineral estates under Native lands would be considered NSO areas. The BLM would authorize sand and gravel mining on a case-by-case basis.

Alternative D

Under Alternative D, the nature and types of impacts on land uses would be as described under *Impacts Common to All Action Alternatives.* Alternative D would open the most land available for leasing sales, with approximately 80.5 percent of the planning area (18,324,000 acres). Among all alternatives, Alternative D would provide the most land available where new surface facilities could be developed (approximately 13,671,000 acres) by making 4,653,000 acres subject to NSO stipulations.

Alternative D would provide the least amount of land unavailable for new infrastructure development among all alternatives, with approximately 4,531,000 acres (19.9 percent of the planning area). With the most lands available where permanent infrastructure could be developed, Alternative D would not authorize any pipeline corridor ROWs near the Teshekpuk Lake Special Area. While no pipeline would be developed, other oil and gas-related infrastructure may be developed in the high hydrocarbon potential zone, potentially creating conflicts with existing land uses from noise, dust, and traffic generated from new uses.

Native allotments under Alternative D would require a 1-mile buffer around them to prohibit oil and gas development except for essential road and pipeline crossing areas of overlap. Federal mineral estate under Native lands would be the same under this alternative.

Cumulative Impacts

The geographic area of the cumulative impacts analysis for landownership and use is the planning area. Cumulative impacts on landownership and uses would be the result of a change in the demand for lands to be transferred out of federal ownership to support a public use or demand for land uses associated with energy or mineral development. Past, present, and RFFAs, described in **Appendix F**, **Section F.3.2.**, that would cumulatively affect landownership and uses include future oil and gas exploration and production, and the associated demand for infrastructure, and community expansion, particularly near North Slope communities, with associated demand for land uses and potential land tenure actions.

Under all action alternatives, new oil and gas exploration and development, such as the Alpine Colville Delta-5 or GMT1 and GMT2, would increase the number and density of uses in the program area; however, NSO stipulations and making lands unavailable to leasing may concentrate new uses to smaller areas. Collocation of shared facilities would alleviate land use impacts on other public uses. Applications for uses would be processed on a case-by-case basis.

Seismic exploration may disrupt current and potential land uses in the planning area. Seismic activity related to the leasing program may disrupt collection of scientific data for geologic and climate-related research in the planning area, particularly near the Teshekpuk Lake Special Area and Utqiaġvik where research facilities are presently located. These impacts, coupled with other projects such as the SAE Exploration 3D surveys, would primarily occur during the exploration phases of oil and gas development.

Expanding interest in the NPR-A and other regions opening for oil and gas leasing may influence land uses in the NSB. Increased development in the NPR-A may increase demand for public services and infrastructure for communities within the NSB. Expansion of community-based infrastructure may increase demand for new residential, commercial, civic, and industrial land uses in these communities.

The effects of climate change described under the *Affected Environment*, above, could influence the rate or degree of the potential cumulative impacts (SNAP 2018).

3.4.2 Cultural Resources

Affected Environment

This section describes the affected environment for cultural resources potentially affected by the BLM's proposed revisions to existing management policies for the NPR-A planning area. The NEPA implementing regulations (40 CFR 1508.14) address the human environment, defined as the "natural and physical environment and the relationship of people with that environment." Furthermore, in addition to the National Historic Preservation Act's implementing regulations (36 CFR 800.3(a)), which require that the federal agency determine whether a federal undertaking has the potential to cause effects on historic properties, NEPA's implementing regulations (40 CFR 1508.27(b)(8)) require the federal agency to consider "The degree to which the action may adversely affect districts, sites, highways, structures, or objects listed in or eligible for listing in the National Register of Historic Places or may cause loss or destruction of significant scientific, cultural, or historical resources."

Neither the National Historic Preservation Act nor NEPA regulations provide an age rule for scientific, cultural, or historical resources; however, NPS historians set the precedent of historic sites being 50 or more years old (Sprinkle 2007). The description of cultural resources below is based on information provided in the NPR-A Final IAP/EIS (BLM 2012) and new data relevant to environmental concerns that have become available since the publication of the NPR-A Final IAP/EIS. The BLM also reviewed scoping comments for this IAP/EIS for information on cultural resources in the NPR-A planning area.

Cultural and Historical Context

The Affected Environment chapter of the 2012 NPR-A IAP (BLM 2012) and GMT2 SEIS (BLM 2018) adequately describe the planning area's cultural contexts, and **Table 3-32** summarizes cultural themes and periods relevant to the North Slope. **Section 3.4.5**. and **Section U.5** in **Appendix U** also provide a cultural overview of the Iñupiat that is relevant to this section.

Cultural Resources in the Planning Area

The Affected Environment chapter of the 2012 NPR-A Final IAP/EIS (BLM 2012) describes the types of cultural resources that are found in the planning area. According to that chapter, less than 3 percent of the total surface area of the NPR-A has been surveyed, and much of the survey work has been concentrated along the major river drainages. A total of 1,912 Alaska Heritage Resources Survey sites have been documented within the planning area with clusters around local communities, river drainages, the Brooks Range foothills, and the coastlines of the Beaufort and Chukchi seas (ADNR OHA 2019). Over 200 of the Alaska Heritage Resources Survey sites within the NPR-A are in areas outside the BLM's surface authority (e.g., Alaska Native allotments and ANCSA corporation lands).

The NSB's Traditional Land Use Inventory database documents important locations remembered by the Iñupiat and represents the most comprehensive inventory of place names, landmarks, traditional land use sites, travel routes, and other places of cultural importance to the North Slope Iñupiat. According to the Traditional Land Use Inventory, there are 925 recorded Traditional Land Use Inventory sites in the planning area (IHLC 2019). It should be noted that many of the sites documented in the planning area were documented prior to the use of global positioning systems (GPS); therefore, the locational accuracy of the reported site locations may not be correct.

Table 3-32
Cultural Themes and Periods of the NPR-A Planning Area

Theme	Period
Paleoindian	13,700–11,800 years ago
American Paleoarctic	10,300–7,500 years ago
Northern Archaic	7,500–3,000 years ago
Denbigh Flint Complex	5,000–2,400 years ago
Choris	3,800–2,200 years ago
Norton	2,600–1,800 years ago
Ipiutak	1,800–1,200 years ago
Birnirk	1,600–1,000 years ago
Thule	1,000–400 years ago
Late Prehistoric Eskimo	700–400 years ago
Iñupiat	Since Time Immemorial
Euro-American exploration	1820s–1880s
Commercial Whaling	1840s–1900s
Ethnographic and Anthropological Research	1880s–Present
Military	1880s–Present
Christian Missionaries	1890s–Present
Reindeer Herding	1890s–Present
Centralization of Communities	1890s–1970s
Trapping and Trading Posts	1900s–1930s
Geologic Exploration and Oil and Gas Development	1900s–Present
Tourism	1930s–Present

Source: BLM 2018, 2012.

No revised statue 2477 trails or National Oceanic and Atmospheric Administration Office of Coast Survey wrecks and obstructions are located within the planning area. A review of the Bureau of Ocean Energy Management shipwreck database did not identify historical shipwrecks within Peard Bay, Kasegaluk Lagoon, Elson Lagoon, or Dease Inlet, which are the major marine areas within the NPR-A planning area. The Bureau of Ocean Energy Management (BOEM 2017) states that submerged, pre-contact sites dating between 20,000 and 3,000 years before the present could exist within the offshore environment depending on the regional landform variation. While the extent of disturbance to submerged landforms is unknown, past research has suggested that areas near barrier islands (i.e., nearshore locations in the planning area) could exhibit less ice gouging and have a greater potential for intact archaeological resources (Darigo et al. 2007). Despite the relatively limited survey coverage of the NPR-A, the large number of cultural sites in the Traditional Land Use Inventory and Alaska Heritage Resources Survey [7] demonstrate that the planning area is filled with culturally important places, especially for the Iñupiat.

Cultural aspects of the environment are not limited to discrete locations containing preserved physical remains of past human activities. Some places may have been, or continue to be, important for their uses for subsistence or religious reasons. Places might be important for sociocultural reasons that are important for social cohesion, institutions, and lifeways that help to characterize cultural identity (National Preservation Institute 2018). These ethnographic resources are places where traditionally associated cultures have formed significant connections with places and/or natural features in the region. The following traditional knowledge from residents in the region describes the holistic nature of cultural resources and what they mean to the Iñupiat:

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[7] Alaska Heritage Resources Survey and Traditional Land Use Inventory data are current as of April 2019. Many sites listed in the Traditional Land Use Inventory are also listed in the Alaska Heritage Resources Survey.

> *To understand our culture is to understand the correlations of history, archaeology, socio economic factors, land and wildlife factors to a livelihood of subsistence patterns of the Iñupiat people. The relationships of history and culture cannot be separated. The same is true for subsistence resources and the human food web process, including organisms of the smallest regime. The total regime of sea mammals, fish, land animals, birds, and caribou is all interrelated and dependent upon each other. To destroy one small part of the regime is to endanger the other parts. One begins to wonder if the hierarchy of State and Federal Governments understand these inter relationships of the total ecosystem as a whole. The total ecosystem provides the network for the continuation of a subsistence lifestyle. Flossie Hopson.* (Utqiaġvik) (MMS 1979a; **Appendix Y**)

> *Cultural resources along the Beaufort Sea coast are not defined in terms of architecture or buildings alone. Beyond such static material categories is a whole panoply of dynamic resources. Spiritual associations with places and activities shared by local residents, subsistence hunting, fishing and gathering pursuits. John Carnahan* (Utqiaġvik) (MMS 1979a; **Appendix Y**)

Besides the NSB's Traditional Land Use Inventory program, surveys and research aimed at identifying and documenting ethnographic resources, such as sacred sites, traditional cultural properties, ethnographic landscapes, or intangible resources, in the planning area have been very limited. One cultural landscape that has been previously identified in the planning area is the Nuiqsut Cultural Landscape, which is described in detail by SRB&A (2013d) and in Section 3.4.2.5 of the GMT 2 FSEIS (BLM 2018). Traditional knowledge provided through oral histories and public scoping testimonies is one avenue of identifying ethnographic resources. Such knowledge can provide traditional knowledge that is general—such as testimony on long-standing use of the Arctic environment—or very specific, such as testimony about use of a specific family subsistence camp.

Existing Impacts on Cultural Resources

Past and present actions that have affected cultural resources are oil and gas exploration, development, and production; onshore and offshore transportation and infrastructure projects; increased recreation and tourism; scientific research; community development; and climate change. Types of effects include, but are not limited to, those that alter a historic property's eligibility for the National Register of Historic Places (per NPS 1991), destruction or possible disturbance of documented and undocumented cultural resources, added noise and visual effects on cultural resources and traditional use areas, and fragmentation of culturally important areas through reduction in access and changes in local resource availability.

Because of the potential existence of many undocumented cultural resources on the North Slope, it is difficult to quantify the extent to which cultural resources have been affected by past and present activities. Generally speaking, earlier exploration and development projects (early oil and gas and seismic exploration, military construction, and community infrastructure projects) on the North Slope had a greater potential to affect cultural resources due to the less stringent regulations and identification requirements than what are in place today. For example, in the planning area, oil exploration trails have been associated with some damage to the Qalluvuk site (TES-00028), a traditional fishing and hunting area that also served as a trading station in the 1930s (ADNR OHA 2016; Keeney 2013). Other observations, testimony, and traditional knowledge by local residents have documented experiences associated with cultural resource impacts, including the following examples:

> *The oil companies travel doing seismic and surveys outside right now with snow vehicles. They should watch what they are doing. They don't know what they are stepping on. There are some graves out there they are running over. I see a lot like that. There is a graveyard southwest maybe 20 miles from here and some survey people don't care what they are doing. Do they have a monitor? Do they hear what Native people say, not to step on or run over [a grave] - a dead person might be under it. Don't just ignore the stakeholders. Watch what you are doing. There is a graveyard out there. It was there before you were there. They did not dig down far in permafrost. Not just one graveyard out there, there are more* (Nuiqsut active harvester; Experience timeline: 1999; Experience location: Fish Creek; Judy Creek. SRB&A Interview 2007) (SRB&A 2009).
>
> *Narrow view of sites. We got grave markers and burials. In the winter we have markers, but they're buried by snow. You get oil companies driving all over the area. That's not right to do. We are Iñupiat. We respect our elders* (Utqiaġvik active harvester. SRB&A Interview 2007) (SRB&A 2009).

See *Cumulative Impacts* for additional discussion and examples of past and present impacts.

Climate Change

A discussion of conditions related to climate change and impacts on cultural resources is described in the Affected Environment chapter of the 2012 NPR-A Final IAP/EIS (BLM 2012). The primary impacts on cultural resources resulting from climate change are erosion (particularly along the coast) and melting permafrost, which can exacerbate the effects of aeolian (wind) erosion, cryoturbation (the action of seasonal freezing and thawing), and solifluction (the downslope the movement of soil as it thaws). These effects can lead to degradation of organic material and disturbance to site integrity and context. Impacts from climate change are not universal across the Arctic in Alaska; in some places, cultural resources may not be as affected (e.g., coastal accretion instead of erosion) or experience noticeable changes.

Direct and Indirect Impacts

Impacts Common to All Alternatives

Development of new infrastructure or a lease in the NPR-A, including the exploration, development, production, and abandonment and reclamation phases of any permitted development, could potentially affect cultural resources (see **Appendix B**, **Section B.8** for a description of the RFD scenario). Such potential impacts include physical destruction of, or damage to, all or part of a cultural resource; removal of a resource from its original location; a change in the character of the resource's use; changes to physical features in a resource's setting that alter important visual, auditory, or olfactory characteristics that are important to the resource; or a change in access to traditional use sites by traditional users. See BLM (2012) Section 4.3.12 for a more in-depth description of the types of impacts associated with oil and gas exploration and development activities, including the effects of seismic surveys, short-term disturbances from exploration and delineation drilling, long-term disturbance from development of oil and gas infrastructure, effects of oil spills and gas releases, and effects of abandonment and reclamation.

The area of high development potential described in the RFD scenario is located in the eastern portion of the NPR-A from Smith Bay and Price River in the west to the Colville River in the east. This would be the area most likely to see development and experience impacts.

When not routed away from cultural resources, ground-disturbing activities can cause the most direct and severe impacts on such resources. Examples of expected ground-disturbing activities include excavation of material sites; construction and maintenance of gravel roads, pads, airstrips, bridges, and culverts; construction of ice roads and pads; construction of vertical support members for power lines and pipelines; and any other disturbance of the ground surface in the proximity of development project components. Other activities and events that could potentially cause direct impacts on cultural resources include seismic and other exploratory activities; damage caused by equipment during the exploration; development, production, and abandonment and reclamation phases of development projects; and unanticipated accidents, such as blowouts, spills, or fires, and subsequent cleanup activities. Certain future impacts, such as oil spills, can contaminate site artifacts and organic materials to make them undatable.

Public testimony provided during the Point Lay scoping meeting stressed the importance that all construction stop immediately if human remains or historical materials are inadvertently discovered. ROP E-13 would help limit the likelihood of inadvertent discoveries, and it requires that all operations be suspended in the event of inadvertent discovery. ROP L-1 would help to limit off-road/pad travel impacts along steam banks by requiring additional studies/surveys related to archaeological resources. Section 4.3.12.2 in BLM 2012 provides additional discussion of potential direct impacts on cultural resources associated with oil and gas exploration and infrastructure development.

Cultural resources beyond the development project footprints could be indirectly affected throughout the five phases of a development project or during any general infrastructure development activity. Examples of indirect impacts on cultural resources could include increased access and potential removal, trampling, or dislocation of cultural resources and culturally sensitive areas by personnel and visitors; complete or partial destruction of a site from erosion, thawing permafrost, and thermokarsting; the loss of traditional meaning, identity, association, or importance of a resource; effects on beliefs and traditional religious practices; or neglect of a resource that causes its deterioration. Traditional knowledge regarding how these types of indirect impacts, such as changes in access, have affected the Iñupiat and their ties to cultural resources, such as camps and hunting grounds, includes the following:

- *We have not been able to have access to our traditional hunting grounds that we were raised with...The Iñupiat have a close relationship with the land and animals. It changed the spiritual need between the Iñupiat people and their traditional hunting grounds because they had a very close relationship between land and animals. Jonah Leavitt.* (Utqiaġvik) (Worl and Smythe 1986)

The effects of climate change described in the *Affected Environment*, above, could influence the rate or degree of the potential direct and indirect impacts.

While potential impacts on specific cultural resource sites would differ by alternative (see discussion below), broader cultural impacts on belief systems would be common across all alternatives (see also effects on belief systems discussed in **Section 3.4.4)**. The Iñupiat oral histories, cultural sites, history, contemporary use, and current beliefs and values demonstrate a well-established and important relationship between the Iñupiat and much of the planning area. Places in the NPR-A that are associated with cultural practices or beliefs rooted in Iñupiaq histories, and that are important for maintaining the cultural identity of the Iñupiat, could be identified and documented as traditional cultural properties or cultural landscapes (Parker and King 1998). To date, no traditional cultural properties or cultural landscapes (other than initial work to identify the Nuiqsut Cultural Landscape) have been documented in the planning area, although the wide array of individual Traditional Land Use Inventory and Alaska Heritage Resources Survey sites in the planning area indicate potential for identifying these types of resources. The apparent absence of traditional cultural properties or cultural landscapes is attributable to a lack of identification research rather than nonexistence.

In summary, given the information currently available and the undetermined location and nature of development in the planning area, potential impacts on traditional belief systems, religious practices, and other ethnographic cultural resources (such as traditional cultural properties and cultural landscapes) could be adverse, regional, and long term. ROP I-1 would help to address broader cultural resource effects by requiring an orientation program to address specific traditional and cultural concerns that relate to the region and cultural resource awareness training to address the importance of not disturbing archaeological sites. Consultation with the tribes during the NEPA and Section 106 processes will occur to further explore options for minimization and mitigation measures related to ethnographic cultural resources.

Cultural resource sites in the planning area that could not be avoided (i.e., experiencing direct effects) or that would experience indirect effects could experience adverse, local, and long-term impacts; however, ROP E-13 requires cultural resource surveys prior to ground-disturbing activities. To date, very few documented cultural sites in the NPR-A have been evaluated for National Register of Historic Places eligibility; thus, unevaluated sites are treated as historic properties pending review, and the BLM elects site avoidance as the best practice to avoid adverse impacts. ROP E-13 requires that activities avoid cultural sites by a minimum of 500 feet from the site boundary. If a future proposed project requires mitigation to cultural resource sites, National Register of Historic Places eligibility will be evaluated as needed. Therefore, no potential adverse effects on documented, specific cultural resource sites would be expected in areas where adequate investigation, such as surveys, consultation, and interviews, has occurred prior to development and where appropriate avoidance, minimization, or mitigation measures are implemented.

The Section 106 process for addressing effects on historic properties occurs concurrently with the NEPA process. It includes consultation and other procedures as set forth in 36 CFR 800 that address the identification of historic properties and resolving potential adverse effects through avoidance, minimization, or mitigation. Individual NEPA and Section 106 reviews will occur for future site-specific developments within the NPR-A in accordance with 36 CFR 800 and the protocol for managing cultural resources on BLM-managed lands in Alaska (ADNR OHA and BLM 2014).

The effects of climate change described under the *Affected Environment*, above, are part of the baseline conditions for cultural resources in the project area. See **Section 3.2.1** for a detailed discussion of the alternatives' contributions to global climate change.

Alternative A

Under Alternative A, the types of potential impacts on cultural resources would be the same as those described above (*Impacts Common to All Alternatives*) and in BLM (2012) Section 4.5.12 for Alternative B-2, which was the preferred alternative chosen in the 2013 ROD for the NPR-A. Under Alternative A, approximately 52 percent (11.8 million acres) of NPR-A's subsurface would be available for oil and gas leasing with different areas subject to standard terms and conditions, BMPs (ROPs in Alternatives B–D), or NSO conditions. There would be no areas governed by controlled surface use or subject to timing limitations. The remaining 11 million acres would be closed to leasing.

According to the available information in the Alaska Heritage Resources Survey, 212 Alaska Heritage Resources Survey sites are in the areas subject to standard terms and conditions and ROPs that would be open to leasing and could experience ground-disturbing activities (**Table 3-33**). An additional 462 Alaska Heritage Resources Survey sites are in the NSO area for Alternative A and would have less potential to be affected, due to the reduced levels of ground-disturbing activities. Lastly, 1,288 Alaska Heritage Resources Survey sites are in areas that would be closed to fluid mineral leasing and would not experience impacts.

Table 3-33
AHRS Sites by Alternative[8] - Fluid Mineral Leasing Analysis

Alternative	Open – Standard Terms and Conditions	TL	CSU	NSO	Closed to Fluid Mineral Leasing
A	212	N/A	N/A	462	1,288
B	148	N/A	N/A	504	1,300
C	580	8	N/A	877	498
D	597	23	13	903	427

Source: BLM GIS 2018
Notes: Some larger sites may overlap multiple lease areas. This table does not include ethnographic resources, which are addressed under *Impacts Common to All Alternatives*.
AHRS = Alaska Heritage Resources Survey
STC = subject only to standard terms and conditions
BMP = best management practices
TL = timing limitations
CSU = controlled surface use
NSO = no surface occupancy

In terms of infrastructure impacts, 211 Alaska Heritage Resources Survey sites are in areas available for new infrastructure. These would be the most likely to experience potential effects. An additional 405 Alaska Heritage Resources Survey sites are in areas closed to new infrastructure except for essential new infrastructure (i.e., essential coastal infrastructure, essential road and pipeline crossing, and essential pipeline crossing). These would have a lower potential for effects compared with those in areas available for new infrastructure (**Table 3-34**). Lastly, 1,135 Alaska Heritage Resources Survey sites are in areas that would be closed to new infrastructure; these would not experience infrastructure-related impacts.

Alternative B

Alternative B would make the fewest number of acres available for leasing and development; therefore, it would have the lowest potential for direct and indirect impacts on documented cultural resources sites (e.g., Traditional Land Use Inventory and Alaska Heritage Resources Survey). Compared with Alternative A, 64 fewer Alaska Heritage Resources Survey sites under Alternative B would be in the areas open to leasing, susceptible to ground-disturbing activities, and subject to standard terms and conditions and ROPs (**Table 3-33**). An additional 504 Alaska Heritage Resources Survey sites (42 more than under Alternative A) would be in the NSO area and would have less potential to be affected, due to the reduced levels of ground-disturbing activities. A total of 1,300 Alaska Heritage Resources Survey sites would be in areas closed to fluid mineral leasing under Alternative B and would not be affected.

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[8] No similar analysis could be conducted for Traditional Land Use Inventory sites in the planning area because the NSB did not provide specific Traditional Land Use Inventory site locations due to the large area of analysis.

Table 3-34
AHRS Sites by Alternative[9] - New Infrastructure Analysis

Alternative	Available for New Infrastructure	ECI	ERPC	EPC	Pipeline Corridor	No New Infrastructure
A	211	82	301	22	N/A	1,135
B	161	53	442	22	4	1,073
C	611	88	593	22	2	441
D	625	107	594	27	N/A	405

Source: BLM GIS 2018

Notes: Some larger sites may overlap multiple lease areas. This table does not include ethnographic resources, which are addressed under *Impacts Common to All Alternatives*.

AHRS = Alaska Heritage Resources Survey
ECI = essential coastal infrastructure
ERPC = essential road and pipeline crossings
EPC = essential pipeline crossings

For potential infrastructure impacts under Alternative B, areas available for new infrastructure would contain the fewest Alaska Heritage Resources Survey sites of all alternatives. When compared with Alternative A, however, areas exempted for essential new infrastructure (i.e., essential coastal infrastructure, essential road and pipeline crossing, essential pipeline crossing, and pipeline corridors) would contain a greater number of Alaska Heritage Resources Survey sites (521 versus 405; **Table 3-34**). Areas unavailable for new infrastructure under Alternative B would contain 62 fewer Alaska Heritage Resources Survey sites than Alternative A; thus, fewer Alaska Heritage Resources Survey sites would avoid impacts by being in areas closed to new infrastructure under Alternative B compared with Alternative A.

Although Alternative B would have 62 fewer Alaska Heritage Resources Survey sites located on areas closed to new infrastructure, potential impacts on cultural resource sites under Alternative B would be of slightly lower intensity than under Alternative A. Alternative B would have the largest setbacks from areas of highest potential for containing undocumented cultural resources (e.g., K-1 and K-5 stipulations), such as rivers and coastline, meaning that this alternative would have the lowest likelihood for affecting undocumented resources. The potential impacts would be adverse, local, and long term for sites that could not be avoided or would experience indirect effects.

Alternative C

Alternative C would make the second-largest number of acres available for leasing and development and infrastructure (approximately 17 million), of which 11.4 million acres would be subject to standard terms and conditions. Therefore, in terms of direct and indirect impacts on documented cultural resource sites (e.g., Traditional Land Use Inventory and Alaska Heritage Resources Survey), Alternative C would have a greater number of sites potentially affected than Alternative A. A total of 588 Alaska Heritage Resources Survey sites would be in standard terms and conditions or timing limitation areas that would be open to leasing, exposing 376 more sites to ground-disturbing activities than Alternative A (**Table 3-33**). Alternative C would increase the number of Alaska Heritage Resources Survey sites in NSO areas with reduced levels of ground-disturbing activities relative to Alternative A; these 877 Alaska Heritage Resources Survey sites (versus 462 under Alternative A) would have less potential to be affected by ground disturbance. A total of 498 Alaska Heritage Resources Survey sites (790 less than Alternative A) would be in areas closed to fluid mineral leasing under Alternative C and would not be affected.

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[9] No similar analysis could be conducted for Traditional Land Use Inventory sites in the planning area because the NSB did not provide specific Traditional Land Use Inventory site locations due to the large area of analysis.

For potential infrastructure impacts, 611 Alaska Heritage Resources Survey sites would be in areas available for new infrastructure (400 more than Alternative A) while an additional 705 Alaska Heritage Resources Survey would be in areas exempted for new infrastructure (i.e., essential coastal infrastructure, essential road and pipeline crossing, essential pipeline crossing, and pipeline corridors) relative to 405 under Alternative A (**Table 3-34**). Areas unavailable for new infrastructure under Alternative C would contain 441 Alaska Heritage Resources Survey sites, 694 fewer than Alternative A; thus, fewer Alaska Heritage Resources Survey sites would avoid impacts by being in areas closed to new infrastructure under Alternative C compared with Alternative A.

Alternative C would open larger areas to leasing with fewer more-restricted areas stipulated by NSO and controlled surface use, relative to Alternatives A or B. Alternative C would, therefore, be more likely than Alternatives A or B to affect undocumented cultural resources. Potential impacts on cultural resource sites under Alternative C would be of higher intensity than under Alternatives A or B and would be adverse, local, and long term for sites that could not be avoided or would experience indirect effects.

Alternative D

Alternative D would make the largest number of acres available for leasing and development and infrastructure (approximately 18.3 million); therefore, in terms of direct and indirect impacts on cultural resource sites (e.g., Traditional Land Use Inventory and Alaska Heritage Resources Survey), Alternative D could affect the greatest number of documented sites (**Table 3-33**). Under Alternative D, a total of 633 Alaska Heritage Resources Survey sites would be in standard terms and conditions, timing limitation, or controlled surface use areas that would be open to leasing and surface occupation, exposing 421 more sites to ground-disturbing activities than Alternative A. Alternative D would increase the number of Alaska Heritage Resources Survey sites in NSO areas with reduced levels of ground-disturbing activities relative to Alternative A; these 903 Alaska Heritage Resources Survey sites (versus 462 under Alternative A) would have less potential to be affected by ground disturbance. A total of 427 Alaska Heritage Resources Survey sites (861 fewer than Alternative A, and the fewest of all alternatives) would be in areas closed to fluid mineral leasing and would not be affected under Alternative D.

For potential infrastructure impacts, 625 Alaska Heritage Resources Survey sites would be in areas available for new infrastructure (414 more than Alternative A), while an additional 728 Alaska Heritage Resources Survey sites would be in areas exempted for essential new infrastructure (i.e., essential coastal infrastructure, essential road and pipeline crossing, essential pipeline crossing, and pipeline corridors) relative to 323 under Alternative A (**Table 3-34**). Only 405 Alaska Heritage Resources Survey sites (730 less than Alternative A) would avoid potential impacts by being in areas closed to new infrastructure under Alternative D.

Relative to all other alternatives, Alternative D would open the largest area to leasing with fewer more-restricted areas stipulated by NSO and controlled surface use. Alternative D would, therefore, have the highest likelihood for affecting documented and undocumented cultural resources. Potential impacts on cultural resource sites under Alternative D would have the greatest intensity and be adverse, local, and long term for sites that could not be avoided or would experience indirect effects.

Cumulative Impacts

The geographic area of the cumulative impacts analysis for cultural resources is the planning area. Past, present, and reasonably foreseeable future activities, in combination with oil and gas development in the planning area, would increase the potential for cultural resource impacts on specific cultural resource sites and other ethnographic resources, such as traditional cultural properties and cultural landscapes. A list of past, present, and reasonably foreseeable future activities considered in this analysis are presented in **Appendix F**, **Table F-1**; the list extends to those actions that could occur over the next 70 years. The impacts of past and present projects on cultural resources in the cumulative effects analysis area are discussed in **Section 3.4.2.**, Existing Impacts on Cultural Resources.

Persistent and/or increased onshore and offshore oil and gas development in the North Slope region could potentially affect cultural resources. Present and reasonably foreseeable activities include such projects as the SAExploration 3D Seismic Exploration Surveys; Colville Delta-5 and other Alpine facilities, GMT1 and 2, Willow, and Nanushuk developments in the Colville River region; Kuparuk; Prudhoe Bay; the Liberty Development in the Beaufort Sea; Point Thomson; and development of a natural gas pipeline from the North Slope to Canada, Valdez, or Cook Inlet (Alaska Stand Alone Gas Pipeline or Alaska LNG pipeline). Other reasonably foreseeable activities that introduce synergistic impacts include additional infrastructure projects, including new permanent and seasonal roads, airport improvements, and community infrastructure improvements; gravel exploration; scientific research; and recreation and tourism activities in the region.

Today, local, state, and federal regulations provide for stricter identification requirements that diminish the chances for direct impacts on cultural resources from projects like those mentioned above. In most instances, avoidance policies are implemented around documented cultural resource sites, particularly those that are eligible for the National Register of Historic Places. However, the potential for impacts, particularly for undocumented cultural resource sites, increases with oil and gas exploration, development, and production; onshore and offshore transportation and infrastructure projects; increased recreation and tourism; scientific research; and community development.

Indirect impacts are harder to avoid or mitigate and could have substantial consequences to cultural resources. Examples include decreased or increased access; potential removal, trampling, or dislocation of cultural resources and culturally sensitive areas by personnel and visitors; complete or partial destruction of a site from erosion, thawing permafrost, and thermokarsting; the loss of traditional meaning, identity, association, or importance of a resource; effects on beliefs and traditional religious practices; or neglect of a resource that causes its deterioration.

The updated Nuiqsut Paisaŋich documented an example of indirect effects affecting traditionally used fish camps near Nuiqsut. Although the site location is physically intact, Nuiqsut families, since the early 2000s, have not used the fish camps located at the traditional *Nanuq* site. During a traditional knowledge workshop, one Nuiqsut resident described the loss of traditional camping and fishing sites due to development saying,

> *Yeah, I say that now because of Alpine we have had some displacement of camping sites, fishing sites. Some families have abandoned because of the development. The impact of noise and traffic and the infrastructure itself the roads and facilities. They tell us we can use our camping grounds to hunt and fish but it's just not… And besides that with the fire arms these days the industry is wary of that* (Nuiqsut) (SRB&A Unpublished-b).

Reasons for the abandonment of the camps are attributed to development of Alpine, resulting changes in caribou migration, and an increase in dust from development that prohibits drying of fish due to the dust settling on the fish racks (SRB&A 2018c). Others attribute the abandonment to decreasing water levels that led to reduced fishing success, possibly an indicator of climate change-induced effects.

The effects of climate change described under the *Affected Environment*, above, introduce additive impacts that could influence the rate or degree of the potential cumulative impacts. In general, the effects of climate change are not uniform across the North Slope, but are negative in that they hasten erosion, permafrost thaw, thermokarsting, cryoturbation, and solifluction, which can disturb sites, degrade preservation, and eventually destroy cultural resource sites. The substantial erosion at the Walakpa site in Utqiaġvik over a relatively short period of time is just one example of many sites in the area being affected by additive effects of climate change.

Another indirect effect example involves the Toolik Lake Research Natural Area on the North Slope, where the increased research, hunting, and recreational activities since the 1970s were recently identified as underlying causes for unauthorized artifact collection and the lack of formal and culturally diagnostic artifacts near the research area (SRB&A 2019). Infrastructure projects could result in greater public access to cultural resources within the planning area, thus resulting in an even greater potential for unauthorized collection or inadvertent disturbance of sites.

Cumulative impacts would have the greatest effect on ethnographic resources, such as traditional cultural properties and cultural landscapes. This is because it is more difficult to avoid or mitigate impacts for these compared with the more definitive cultural resource sites. The significance of traditional cultural properties and cultural landscapes is tied to historic and modern cultural identity that relates to a landscape and its natural resources. Thus, a change to the landscape and resources, such as the Nuiqsut Cultural Landscape, within such an area by development can affect cultural identity and the significance of a traditional cultural property or cultural landscape.

Therefore, the action alternatives, in combination with other oil and gas exploration and/or proposed development or recreation on the North Slope, have the potential to create cumulative effects on cultural resources. Alternatives that allow the greatest amount of land to be developed are likely to have the greatest cumulative effect on cultural resources. This is because they could affect a greater number of documented and undocumented cultural resources; thus, Alternative D would have the largest contribution to cumulative effects on cultural resources, while Alternative B would have the smallest contribution to cumulative effects on cultural resources.

3.4.3 Subsistence Uses and Resources

Affected Environment

This affected environment addresses subsistence uses and resources of communities that use the planning area or resources that migrate through the planning area and are harvested elsewhere. For the purposes of this analysis, there are six primary subsistence study communities: Anaktuvuk Pass, Atqasuk, Nuiqsut, Point Lay, Utqiaġvik, and Wainwright. These communities are closest to the planning area and have subsistence uses in or near it or rely heavily on resources that use it.

This section also describes the subsistence uses of two other tiers of subsistence users: those who have peripheral or intermittent use of the planning area (hereafter called peripheral study communities) and the subsistence uses of caribou by Alaskan communities that rely on these two herds for their subsistence caribou harvests (hereafter called caribou study communities). The later tier is discussed because of the importance of the planning area to caribou—particularly the Western Arctic Herd and the Teshekpuk Caribou Herd.

Based on a review of subsistence use area information, the peripheral study communities are the seven Northwest Alaska communities of Ambler, Kiana, Kobuk, Noatak, Noorvik, Selawik, and Shungnak, all of which have documented uses in the southern portions of the NPR-A. The caribou study communities addressed in this section associated with the Western Arctic Herd are based on the 42 communities that are members of the Western Arctic Herd Working Group. The 42 Western Arctic Herd Working Group communities also include the five primary communities that harvest from the Teshekpuk Caribou Herd (Utqiaġvik, Atqasuk, and Nuiqsut and to a lesser extent Wainwright and Anaktuvuk Pass), which has a more concentrated range (see Braem 2017). All primary and peripheral study communities are also members of the Western Arctic Herd Working Group; therefore, the total number of study communities for this analysis is 42. A full list of the subsistence study communities and an associated map is provided in **Appendix T, Table T-1** and **Appendix A, Map 3-20**.

Additional associated information relevant to subsistence is in **Section 3.4.4**, which addresses cultural history, social and political organization, mixed cash/subsistence economy, and cultural values and belief systems; **Section 3.4.2** addresses the cultural and historic context of the planning area and cultural resources there.

Subsistence Definition and Relevant Legislation

Subsistence is a central aspect of rural life and culture and is the cornerstone of the traditional relationship of the indigenous people with their environment. Residents of the study communities rely on subsistence harvests of plant and animal resources, both for nutrition and for their cultural, economic, and social well-being. Activities associated with subsistence—processing, sharing, redistribution networks, cooperative and individual hunting, fishing, gathering, and ceremonial activities—strengthen community and family social ties, reinforce community and individual cultural identity, and provide a link between contemporary Natives and their ancestors. These activities are guided by traditional knowledge, based on a long-standing relationship with the environment. One such traditional knowledge observation emphasized the vital importance of sharing to the Iñupiat way of life and the strengthening of community ties that occurs during subsistence activities:

> *It's really more a way of life. As you know, subsistence is an unfortunate term, it's really a lifestyle. And gathering wild foods and that sort of thing, is, is super important in a lot of cultures, but definitely here. And you know you hear the cliché that whaling brings the community together. It's true, it really is true. It's amazing. People that have been campaigning against each other, all this kind of rough stuff, when a whale is caught all that goes away and food is shared. And that sharing hasn't changed. In fact, that is probably the single most impressive, or important, let's say, aspect of the way things are done here. Is that it's, it's sort of communal hunting. And the way people distribute food is really amazing. And you can tell it's absolutely genuine.* (Utqiaġvik) (Brown et al. 2016; **Appendix Y**)

In Alaska, subsistence hunting and fishing are regulated under a dual management system by the State of Alaska and the federal government. Subsistence activities on all lands in Alaska, including private lands, are subject to state or federal subsistence regulations; the State of Alaska manages the harvest of fish and wildlife on ANCSA corporation-owned land. The planning area is comprised of federal lands managed by the BLM; therefore, the federal management for subsistence uses in the planning area is governed by Title VIII of the Alaska National Interest Lands Conservation Act. BLM (2012), **Section 3.4.3.1**, provides a more in-depth discussion of subsistence management in the planning area.

Overview of Subsistence Uses

The following sections provide a brief overview of subsistence uses for the six study communities. Additional subsistence data tables are provided in **Appendix T**, and maps are provided in **Maps T-1** to **T-14** in **Appendix T**. The sources of information used in this EIS to directly inform subsistence use areas, harvest patterns, and seasonal rounds are summarized in **Appendix T**, **Table T-2**. Other sources provide additional descriptions of subsistence or contain data that are relevant to subsistence but are not directly comparable to the information in this section, such as reported versus estimated harvests and Native households versus all households. These sources include the NSB census reports and community plans (NSB 2016), which include subsistence data that focus on Native households and selected resources.

Subsistence Use Areas—Where are Communities Harvesting?

Residents of the six primary study communities use an expansive area where they harvest subsistence resources. These use areas represent the combination of several mapping studies conducted in each of the communities during different years. Maps of each community's subsistence use areas from available studies are shown in **Appendix T**, **Maps T-2** through **T-14**.

The combined use areas for these four communities extend from the Chukchi Sea coast and headwaters of the Colville River in the west, toward the ANWR in the east. Marine resource uses are in the Beaufort and Chukchi seas, and terrestrial and riverine resource uses extend as far south as the Brooks Range and along the Noatak River. Snowmachines are the primary mode of transportation to access winter and spring use areas; boat is the primary mode of transportation in the summer and fall, and some areas are accessed by all-terrain vehicles during the ice-free months.

Whereas other North Slope study communities use boats during the summer to access marine and riverine use areas, Anaktuvuk Pass residents travel to summer use areas primarily by all-terrain vehicles. Due to oil and gas development in the Nuiqsut area and eastern NPR-A, Nuiqsut residents have begun using trucks for subsistence purposes on roads that connect the various developments in their area. Ice roads are also sometimes used by subsistence harvesters.

Nearly all types of terrestrial and riverine subsistence resources are pursued by Natives in the NPR-A study communities. Atqasuk, Nuiqsut, Point Lay, Utqiaġvik, and Wainwright have documented subsistence uses in the NPR-A for a variety of resources, including large land mammals (primarily caribou or moose), furbearers and small land mammals, non-salmon fish, waterfowl, upland game birds, and vegetation. Marine mammals and salmon harvesting is less common in the NPR-A; instead, they are harvested in nearshore areas, such as Peard Bay, Elson Lagoon, and Kasegaluk Lagoon, where NPR-A management actions for the offshore/marine environment are proposed.

Due to its distance from the NPR-A, Anaktuvuk Pass has fewer uses directly in the planning area. These uses are hunting of caribou, furbearers, and small land mammals, primarily wolf and wolverine. Wainwright and Point Lay subsistence use areas are primarily in the western portion of the NPR-A; Atqasuk use areas are in the central and northern portion; and Nuiqsut use areas are focused on the eastern and northern portion. Utqiaġvik use areas extend throughout most of the NPR-A but focus on the northern, central, and eastern portions. Anaktuvuk Pass use areas of the NPR-A are somewhat peripheral and extend into the southern and southeastern portions, along the Colville River drainage.

Based on available data, areas of high overlapping use for Nuiqsut, Point Lay, and Utqiaġvik are in the NPR-A; for Nuiqsut, high overlapping use is in the northeastern portion of the NPR-A, between the Colville River and Fish Creek, with moderate overlapping use extending south of Teshekpuk Lake for wolf and wolverine hunting (SRB&A 2010b). For Point Lay, moderate overlapping use is in overland areas in the western portion of the NPR-A with some high overlapping use extending into the NPR-A along the Utukok and Kokolik rivers. Utqiaġvik areas of high overlapping use are in the northern portion of the NPR-A and along the Inaru, Meade, Chipp, Topagaruk, and Ikpikpuk rivers, in addition to moderate overlapping use extending in overland areas between those drainages and to Teshekpuk Lake.

Subsistence Harvest Patterns—What are Communities Harvesting?

Residents of all six primary study communities use a broad base of resources to meet their subsistence needs. Individual community reliance on various subsistence resources is driven primarily by the geographic location of the community. See **Appendix T**, **Table T-3** through **Table T-8,** for subsistence harvest information for resource categories, such as large land mammals, and associated species, such as caribou. This information has been averaged for all available study years for the six primary study communities.

For communities on the coast (e.g., Point Lay, Utqiaġvik, and Wainwright), marine mammals provide the greatest proportion to overall community harvests, ranging from an average of 49 percent in Utqiaġvik to 59 percent in Point Lay. In terms of harvest contribution, marine mammals are followed by large land mammal and non-salmon fish harvests. Nuiqsut, which is along the Colville River but with easy access to the Beaufort Sea, has a more evenly distributed level of harvests between marine mammals, large land mammals, and non-salmon fish. Lastly, the inland communities of Atqasuk and Anaktuvuk Pass rely on large land mammals to provide the bulk of their harvest. Anaktuvuk Pass in particular relies on a single land mammal, caribou, for nearly 90 percent of its subsistence harvests. In all communities, vegetation and birds and their eggs also contribute to the subsistence harvest.

Residents in the primary study communities have reported harvests ranging from an average of 217 pounds per person (Utqiaġvik) to 775 pounds per person (Wainwright). Harvest amounts vary from year to year and certain resources, such as bowhead whales, which can contribute as much as 25,000 pounds to a community's total harvest, can make a major difference in a community's per capita harvest during a given study year.

In addition to harvesting subsistence resources to meet their household needs, harvesters share with other members of the community and with other communities in the region. Anaktuvuk Pass, which does not have access to marine resources, often receives marine mammals from coastal communities, and in turn, shares caribou with these communities. On average, 87 percent or more of households in the primary study communities report receiving subsistence resources.

Subsistence measures of community participation (percent of households trying to harvest), community sharing (percent of households receiving), and community harvests (percent of total harvest) provide indicators of the relative importance of various subsistence resources to study community residents (see **Appendix T**, **Tables T-3** through **T-8**). Based on these three measures, the resources of higher importance to study communities are as follows:

- Anaktuvuk Pass—large land mammals (primarily caribou), non-salmon fish, vegetation, and marine mammals (due to the high number of households receiving this resource)
- Atqasuk—large land mammals (primarily caribou) and non-salmon fish[10]

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[8] Atqasuk harvest data for trying to harvest and receiving are not available for resource categories, therefore, the list of resource importance is likely understated

- Nuiqsut—large land mammals (primarily caribou), non-salmon fish, marine mammals, and migratory birds
- Point Lay—marine mammals, large land mammals (primarily caribou), non-salmon fish, migratory birds, and vegetation
- Utqiaġvik—marine mammals, large land mammals (primarily caribou), non-salmon fish, and salmon (due to the high number of households receiving this resource)
- Wainwright—marine mammals, large land mammals (primarily caribou), non-salmon fish, migratory birds, and vegetation

Impacts on these resources would have the greatest consequences for subsistence users.

Subsistence Timing—When are Communities Harvesting?

Data on the timing of subsistence activities (i.e., seasonal round) are available for the six primary study communities. The timing of subsistence activities for residents of the North Slope region, based on a compilation of the most recent available data for each community, is provided in **Appendix T**, **Table T-11**. Residents of individual North Slope region study communities may harvest in additional months for a specific resource or harvest additional resources that are not depicted in **Appendix T**, **Table T-11**, such as egg gathering in Nuiqsut. Seasonal subsistence activities for the individual study communities are summarized in **Appendix T**, **Tables T-12** through **T-17**.

Spring (April and May) subsistence activity in the North Slope region varies among communities; however, the common focus is on hunting waterfowl as they migrate through the area; Utqiaġvik, Wainwright, and Point Lay also hunt bowhead whales in the spring. Seal harvests are a focus of the coastal communities starting in the spring, while some caribou hunting can occur for all communities during this time. Upland bird and some small land mammal harvests also take place during the spring. Spring marks the end of the furbearer harvesting season.

The summer months of June, July, and August are a peak time for harvests of salmon and non-salmon fish. Caribou subsistence activity occurs year-round but is particularly common during the summer, as the caribou seek relief from insects in coastal areas and remain in the area until their fall migration to wintering grounds farther south. Residents of the North Slope Region diversify large land mammal subsistence activities during the summer, with harvests of moose, bear, and muskox. Coastal community residents also focus on marine mammal resources, such as bearded seals and walrus, using the open water offshore. Waterfowl harvests continue through the summer and into the fall migration. The timing of plant and berry harvests is limited, due to a brief growing period, and occurs over the summer into early fall.

Fall (September and October) in the North Slope Region is an important time for coastal communities, particularly Utqiaġvik and Nuiqsut, to harvest migrating bowhead whales. Subsistence activity for moose, Dall sheep, and freshwater fish, particularly Arctic cisco, burbot, and broad whitefish, also amplifies during the fall. Residents continue to target caribou remaining through the fall, with heightened activity during their fall migration south, while subsistence activity for marine mammals such as seals and walrus decreases. Upland bird (ptarmigan) hunting increases in the fall and into winter.

Winter (November through March) is the prime time for harvesting furbearing animals and upland birds. Dall sheep are also hunted in late winter (March) in certain communities. Freshwater fishing declines from late summer and fall but still occurs throughout the winter. Caribou harvests remain a focus over the winter, particularly in Anaktuvuk Pass. Marine mammals, specifically ringed seals, continue to be harvested through the winter in the coastal communities, though to a lesser extent than during the rest of the year.

Peripheral Uses of the NPR-A

As discussed above, seven additional communities in Northwest Alaska have documented subsistence uses in the NPR-A. These uses are on the periphery of these communities' core subsistence use areas but nonetheless may be important, particularly for the specific resource that is targeted. These resources are primarily caribou, furbearers and other small game, with some hunting of Dall sheep and bear by a few communities. The specific resources pursued in the NPR-A by the peripheral communities are as follows (see **Appendix T**, **Tables T-3 through T-8** for details on these uses):

- Ambler—caribou, sheep, furbearers, small game
- Kiana—caribou, bear, furbearers, small game
- Kobuk—caribou, sheep, furbearers
- Noatak—caribou, furbearers
- Noorvik—caribou, furbearers
- Selawik—caribou
- Shungnak—caribou, sheep, bear, furbearers, small game

Harvest data for the peripheral study communities are provided in **Appendix T**, **Tables T-16** through **T-22**. Caribou is a key subsistence resource among many of the peripheral study communities, providing between 30 and 50 percent of the total subsistence harvest during some years. While furbearers and small game provide less in the way of edible pounds, furbearer hunting and trapping remains an important cultural activity for these communities. Dall sheep and bear are other animals that provide a minimal amount in terms of edible pounds, but they remain a key subsistence use in many of the peripheral study communities.

Peripheral study communities' uses of the NPR-A are only documented for "lifetime" uses between 1925 and 1985 (**Appendix T**, **Map T-8** through **Map T-14**). More recent documented subsistence use areas do not extend as far as the NPR-A; however, these communities likely still have traditional and cultural ties to the NPR-A and have uses of areas directly to the south of it.

Subsistence Uses of Caribou

Caribou use and harvest averages across all available study years are provided in **Appendix T**, **Table T-23**, for the additional caribou study communities listed in **Table T-1** and depicted on **Appendix T**, **Map T-1**. Caribou uses of primary and peripheral study communities are addressed in **Tables T-3** through **T-8** and **Tables T-16** through **Table T-22**. Caribou is a key subsistence resource for all these study communities.

With few exceptions, use of caribou among the 42 study communities is high; over 50 percent of households in 30 of the 42 study communities use caribou. The contribution of caribou toward the total subsistence harvest is highest in Anaktuvuk Pass, Ambler, Atqasuk, Buckland, Deering, Koyuk, Noatak, Shungnak, and White Mountain. Caribou contributes an average of at least one-third of the total harvest in those communities.

Caribou sharing ranges widely, with between 2 and 71 percent of households giving caribou and between 3 and 84 percent receiving caribou. On average, caribou contribute approximately 25 percent toward the total harvest for the study communities. Nearly half of households (48 percent) participate in caribou hunting, and residents harvest an average of 101 pounds of caribou annually.

Current Impacts on Subsistence

Impacts on subsistence are occurring on the North Slope with greater frequency as development expands across the region; therefore, impacts should be considered as part of the baseline of subsistence uses. Nuiqsut, the community closest to current oil and gas development on the North Slope, has experienced the most impacts; therefore, this section provides a summary of the various sources of impacts on subsistence on the North Slope over time and an assessment of current levels of subsistence impacts, using Nuiqsut as a primary example.

There are various environmental and social factors that have affected North Slope subsistence harvesting patterns, such as climate change, sport hunters, technological advances; however, development, particularly oil and gas development, has been the primary concern and source of impacts reported by North Slope residents over the years (SRB&A 2009a); thus, development impacts are the focus of this discussion. Starting as early as the 1970s, during public hearings, residents voiced concerns about development to the east of Nuiqsut, and as development moved westward, reported impacts increased. The Alpine Development represented the first major oil and gas development in the Colville Delta, and the Nuiqsut Subsistence Caribou Monitoring Project was implemented to monitor the impacts of the Alpine and Alpine Satellites developments on Nuiqsut caribou hunting; however, impacts on subsistence were already occurring by the time development arrived in the Colville Delta.

A review of public testimony on the North Slope by SRB&A (2009a) revealed the top impact concerns as displacement of wildlife, EIS deficiencies, climate-development effects, release of contaminants, disruption to and contamination of wildlife, and cumulative impacts. Specifically for Nuiqsut, a review of documents associated with the Alpine Satellites, Endicott, and Northstar projects showed that difficulty hunting and displacement of wildlife were the primary impact concerns reported; caribou, bowhead whales, and fish were the most commonly mentioned resources of concern (SRB&A 2010a). Furthermore, during a survey of active harvesters in Nuiqsut in 2007, over half of the individuals interviewed indicated they had personally experienced the following impacts related to oil and gas development: difficulty hunting, displacement of wildlife, contamination/extraction of materials, disruption of wildlife, effects of development on wildlife, decreased habitat, and ability to hunt (SRB&A 2009a).

Nuiqsut residents use both the marine and terrestrial environments for subsistence, and therefore both onshore and offshore oil and gas development have the potential to affect those activities. Sources of development-related impacts are infrastructure, such as pipelines, bridges, pads, and roads; noise from air, ground, and vessel traffic; seismic exploration; noise from construction and drilling; security restrictions; and release of contaminants through spills and emissions.

Other North Slope communities have reported impacts on subsistence activities related to oil and gas exploration and development. Subsistence impacts and concerns have been documented for Point Lay, Wainwright, Utqiaġvik, Atqasuk, and Anaktuvuk Pass in numerous publications (SRB&A 2014b, 2017b, 2013a, c, 2010b, 2009a, EDAW Inc., Consulting, Research, Callaway, Associates, and Economics 2008). Many of these concerns are related to offshore leasing, seismic activity, and oil exploration in the Chukchi Sea (for Point Lay, Wainwright, and Utqiaġvik) and effects of development, including seismic activity and oil and gas-related research and traffic, on such terrestrial resources as caribou. Traditional knowledge observations regarding these types of impacts include the following:

> *When I went camping last year, I waited 3 days for the herd, to have a helicopter to divert them away from us. When they were diverted, we went without. We have had to deal with harassment. We had overflights three times while trying to cut the harvest. It*

> *is disturbing. The next year we had a helicopter do the same thing, but it was worse. They were carrying a sling going from Alpine to Meltwater, another oil field. It went right over us three times. The herd was right there, and it put us at risk. I had my two young sons with me, and it made me very angry. What am I to do when the activities that have been handed down for thousands of years to our people are being changed by the global need for energy?* (Mayor Rosemary Ahtuangaruak, USDOI, BLM, 2004) (Nuiqsut) (MMS 2007)

> *We experienced four years of no caribou with -- because of aircraft noise, mostly with helicopters and our migration - Western Arctic Herd that came from the south was diverted inland to where for four years, we had basically no caribou and the caribou that we had were... Real skinny, no fat caribou and it was four years, you know, even -- even we got so desperate for caribou meat, we had -- some people went up to Icy Cape, even myself, and also we went up to Wainwright just to harvest caribou* (Point Lay) (BLM 2014).

> *Yes, [ice road activity] affects me. It makes me nervous at the same time. I don't like to shoot my rifle towards this. There's an ice road southwest toward Colville Delta-5; that makes me nervous. I know there's traffic out there. I don't like to shoot my rifle toward southwest and even if I try to shoot that caribou, pointing my rifle toward southwest there's traffic, caribous, tracks, rolligons, you name it, it's out there. That scares me, makes me nervous. I always thinking about shooting my rifle northeast because there's less traffic. More traffic going southwest. On facing southwest there's more traffic. That make me nervous, super. There's people out there just traveling. They're walking sometimes, doing seismic. October, November, December. Rolligon, cat train. I look with my binoculars and see people walking* (Nuiqsut) (SRB&A 2010c; **Appendix Y**).

For a more in-depth description of subsistence impacts on the North Slope, see SRB&A (2018b, 2017a, 2016, 2015, 2014a, 2013b, 2012, 2011, 2010c, 2009a) and EDAW Inc. et al. (2008).

Oil and gas exploration development is not the only source of impacts on the North Slope. Other impacts that have been reported by North Slope subsistence users are harvest regulations; air traffic associated with scientific research and recreation; scientific research, such as tagging, and its impacts on wildlife resources; sport hunting and fishing along the Dalton Highway and elsewhere; and shipping traffic.

Harvest data indicate that development has not had community-level impacts on Nuiqsut harvest amounts, success, or participation; however, impacts on individual success rates and harvest amounts have been reported by Nuiqsut subsistence users. The primary impacts that have been documented are changes in subsistence use areas, due to harvester avoidance and introduction of infrastructure, such as roads; impacts on harvester effort and success related to air and road traffic, human-made structures, and security restrictions; and changes in resource availability in traditional hunting areas. Other impacts that have been reported by community residents but are not addressed in detail here are contamination of resources, air pollution, and cumulative impacts on cultural identity and social ties.

Climate Change

A discussion of conditions related to climate change and impacts on subsistence is described in the Affected Environment chapter of the 2012 NPR-A Final IAP/EIS, Section 3.4.3.5 (BLM 2012). That discussion focuses on the five primary changes affecting subsistence: access, species, ice cellars, water, and windstorms. In summary, climate change could contribute to the impacts of increased infrastructure and activity in the region by affecting the availability of subsistence resources and user access to harvesting areas. Changes in the predictability of weather conditions, such as the timing of freeze-up and breakup, snowfall, storms and winds, and ice conditions, can prevent individuals from traveling to subsistence use areas when resources are there or cause greater risks to safety when travel conditions are not ideal. Changes in water quality, depths, and drying or expanding lakes can influence travel conditions, resource availability, and even the quality and availability of drinking water. Lastly, changes in resource abundance from climate change could contribute to changes in resource availability caused by development in and around the planning area, further reducing resource availability to subsistence users.

Some changes from climate change may be viewed as positive, such as higher water levels on some rivers enhancing travel, appearance of more salmonberries, and fish moving into lakes they previously had not been in; however, most changes require adaptations by subsistence users, as traditional harvesting methods that developed over time to ensure safe and successful harvests are challenged by the changing environment.

Direct and Indirect Impacts

Oil and gas leasing could lead to post-lease activities, including oil and gas exploration, development, production, and abandonment and reclamation. The management plan may also permit or restrict other activities within the NPR-A, such as gravel mining and development of community infrastructure, such as roads and pipelines; seismic surveys of unleased areas; scientific research and activities; and construction of pipelines transporting oil and gas from offshore leases. Therefore, this analysis is of potential direct and indirect impacts on subsistence uses from on-the-ground post-lease activities, other oil and gas activities in unleased areas, mining, infrastructure development, and scientific and other research and activity in the NPR-A.

Development, research, and associated activities in the planning area would likely affect subsistence users' access (resulting from legal or physical barriers), resource availability (resulting from resource migration, distribution, or health), and resource abundance (resulting from overall population changes). Following BLM Alaska guidance (Instruction Memorandum No. AK-2011-008), these are the three impact categories that must be addressed to inform the Alaska National Interest Lands Conservation Act Section 810 preliminary evaluation.

Common types of direct and indirect effects on subsistence associated with oil and gas development in the planning area are changes in subsistence use areas, harvest success, harvest amounts, participation, costs and time, competition, culture, barriers to access, both physical and legal, and user avoidance. The RFD scenario (**Appendix B**, **Section B.8**) is used to inform the analysis of subsistence impacts for each alternative, but future analyses would occur with site-specific proposals.

Impacts Common to All Alternatives

This section discusses potential impacts on subsistence uses from potential actions resulting from an updated NPR-A IAP; these impacts are oil and gas leasing, exploration, development, production, and abandonment and reclamation; seismic activities in unleased areas; oil and gas infrastructure in unleased areas; sand and gravel mining; other infrastructure development; and other non-oil and gas activities.

The primary actions that may result in impacts on subsistence resources and uses are as follows:

- Noise, traffic, and human activity
- Infrastructure, including physical barriers

- Contamination
- Legal or regulatory barriers
- Increased employment or income/revenue
- General development and associated cultural impacts

These factors could affect resource availability, resource abundance, and user access for residents of the study communities.

Most subsistence effects would affect communities in the NPR-A planning area—Atqasuk, Nuiqsut, Utqiaġvik, and Wainwright, or Point Lay, which has substantial overlapping use of the NPR-A; even so, a number of subsistence effects could extend beyond the NPR-A region-wide to other North Slope communities, such as Anaktuvuk Pass, or to communities outside the NPR-A with peripheral uses of it, such as Ambler, Kiana, Kobuk, Noatak, Noorvik, Selawik, and Shungnak, or the 42 Western Arctic Herd and Teshekpuk Caribou Herd study communities. The specific communities and regions that could be affected are discussed below for the various types of effects. The duration for subsistence effects would be long term, lasting longer than 5 years. Short-term, or lasting less than 5 years, does not necessarily reflect the level of impact on subsistence uses; an impact lasting 4 years, for example, could have a large effect on subsistence uses.

In almost all cases, future development in the NPR-A would directly affect subsistence uses of resources of major importance for the primary subsistence study communities; direct effects would be less likely for Anaktuvuk Pass, which has only peripheral uses of the southern and southeastern portions of the NPR-A (see **Appendix T**, **Tables T-3** through **T-8**; **Maps T-1** through **T-14**). As described in *Affected Environment*, above, Atqasuk, Nuiqsut, Point Lay, Utqiaġvik, and Wainwright are the primary users of the NPR-A and would therefore be most likely to experience direct impacts from development; however, Nuiqsut and Utqiaġvik show the most use of areas of high hydrocarbon potential in the NPR-A. Atqasuk and Wainwright uses are primarily in areas of medium and low hydrocarbon potential, and Point Lay uses are in areas of low hydrocarbon potential; thus, while the likelihood of direct impacts is higher for Nuiqsut and Utqiaġvik, if oil and gas leasing and development were to occur in areas of medium to low hydrocarbon potential, then Atqasuk, Wainwright, and Point Lay would also experience direct impacts on key subsistence activities at levels similar to Nuiqsut and Utqiaġvik.

Anaktuvuk Pass could experience indirect impacts from development of oil and gas and infrastructure in the eastern portion of the NPR-A, which is directly to the north of Anaktuvuk Pass harvesting areas for numerous resources. It has one of the highest levels of reliance on caribou of all of the study communities and relies on caribou migrating from areas of high hydrocarbon potential into traditional harvesting areas; therefore, that community could be particularly vulnerable to changes in the availability of caribou.

The peripheral communities of Ambler, Kiana, Kobuk, Noatak, Noorvik, Selawik, and Shungnak all have lifetime (1925–1985) subsistence use areas for terrestrial mammals overlapping the southern portion of the NPR-A. In all cases, more recent documented subsistence use areas do not overlap with the NPR-A; thus, it is more likely that these communities would experience indirect impacts on subsistence uses if there are changes to the availability or abundance of terrestrial subsistence resources from NPR-A development. In addition, it is possible that decreased harvest success resulting from disruption to resource availability could lead to rural users advocating for changes in federal harvesting regulations, which could affect other non-rural subsistence users.

In the case of the 42 communities where documented uses of the Western Arctic Herd or Teshekpuk Caribou Herd are documented, these communities could experience indirect or cumulative effects from development of the NPR-A in the range of these herds. The resulting impacts would be on resource distribution, migration, health, and abundance. Use of caribou in most of the 42 caribou study communities is high (see *Affected Environment*, above).

Noise, Traffic, and Human Activity

Noise, traffic, and human activity associated with post-leasing oil and gas activities, non-oil and gas activities, oil and gas activities in unleased areas, and infrastructure development would result from construction, gravel mining, air, vessel, and ground traffic, seismic activity, drilling, and human presence. Noise, ground and air traffic, and human activity can cause both direct and indirect impacts on subsistence users.

In general, activity levels and associated noise and traffic would be greatest during the development phase of potential projects and would be at lower levels during exploration, production, and abandonment and reclamation. Noise, traffic, and human activity would be local in extent and long term.

Impacts related to noise and traffic have been a primary concern reported by subsistence harvesters on the North Slope and elsewhere. Noise and traffic associated with leasing in the NPR-A could affect the availability of resources, such as caribou, marine mammals, furbearers, small land mammals, fish, and migratory birds. While most impacts related to noise and traffic would be local, occurring where subsistence use areas overlap action areas, certain impacts, particularly those related to caribou migration, could extend outside the NPR-A and would be regional. Even small changes in resource migration or distribution, from a biological perspective, can have larger impacts on subsistence users if resources are not in traditional use areas at expected times of the year.

According to traditional knowledge of North Slope Iñupiat, furbearers, caribou, and marine mammals are particularly sensitive to noise and human activity (SRB&A 2018b, 2009a):

> *Hunting caribou; when we hunt caribou on the tundra where there are no trees, you've got to be very unobtrusive, there's nothing to hide behind. We were up at our camp, and this has happened many times, were sneaking up on the caribou, and over a hill, bingo, there comes a helicopter; there goes the caribou. Same place, different time we went up there. There are signs all around that the caribou were there, but then there are ruts, deep tracked ruts in the ground where there have been vehicles, tracked vehicles. Caribou don't go where they've been chased out of. Over a couple of years, they change their activities. Same area, they have restrictions on activities, and some drivers didn't follow there where they were supposed to, and some broke through the river and spilled oil and left various foreign objects and never cleaned it up. That's part of why there's no fish there. About this time of year we'll take off on our snow machines and go wolverine and wolf hunting. Where do we go hunting? We go right here at Cape Simpson but there aren't going to be any out there. And what about all the money and time it takes to do this? I'm debating if it's even worthwhile* (Barrow active harvester; Experience timeline: Since 2000 and ongoing; Experience location: Chipp 6. SRB&A Interview 2007) (SRB&A 2009a; **Appendix Y**).

Potential impacts on caribou availability are the displacement of caribou from areas of heavy oil and gas activity, diversion of caribou from their usual migratory routes, and skittish behavior, which results in reduced harvest opportunities (SRB&A 2018b).

Air traffic, particularly helicopter traffic, has been the most commonly reported impact on caribou hunting by Nuiqsut harvesters since the Nuiqsut Caribou Subsistence Monitoring Project began in 2009. Residents note that air traffic can cause skittish behavior in caribou, either causing them to stay inland from riversides or diverting them from their usual migration and crossing routes. Such potential impacts could occur for NPR-A harvesters as they travel along the coast or rivers by boat or inland by snowmachine looking for caribou. While oil and gas development is a primary source of air traffic on the North Slope, other sources of air traffic include scientific and agency research, recreational uses, and commercial flights.

Ground traffic has also been observed diverting or delaying caribou movement across roads, and biological research has shown that caribou, especially cows with calves, avoid roads and other areas of human activity (see **Section 3.3.6**). Impacts from roads are particularly high during times of high ground traffic (more than 15 trips per hour); impacts from roads are discussed in further detail under *Infrastructure*, below.

Impacts from air and ground traffic would be highest during the peak caribou hunting season, which, for most communities in the NPR-A, occurs from June through October (SRB&A 2010b, 2014b, 2018b). Impacts could also occur in winter, when residents hunt for wintering caribou by snowmachine. Winter seismic exploration has the potential to displace caribou, which could affect winter harvests of caribou; this would be particularly likely for Teshekpuk Caribou Herd caribou, many of which remain in the NPR-A year-round (see **Section 3.3.5**). The Western Arctic Herd and Teshekpuk Caribou Herd are in the NPR-A throughout the spring calving and summer insect seasons (May through August). The Western Arctic Herd calving occurs primarily in the Utukok River uplands in the southwestern portion of the NPR-A, and Teshekpuk Caribou Herd calving occurs near Teshekpuk Lake in the northeastern portion of the NPR-A.

The Central Arctic Herd sometimes travels into the northeastern portion of the NPR-A but generally stays to the east of the Colville River (**Section 3.3.6**). The Western Arctic Herd generally winters to the south of the NPR-A following the fall migration, while much of the Teshekpuk Caribou Herd remains in the NPR-A throughout the winter, with some heading south into the Brooks Range.

Avoidance or other responses to noise and traffic may be more likely for Western Arctic Herd caribou, as they have had less exposure to development than the Teshekpuk Caribou Herd; however, for both herds, exposure to development is relatively limited, compared with the Central Arctic Herd. If development causes large-scale displacement from Teshekpuk Caribou Herd or Western Arctic Herd calving grounds, then the herd could experience a decline in calf survival and stagnant herd growth, thus affecting the availability of caribou to the NPR-A and other communities.

Moose occur primarily in the southern portion of the NPR-A, along the upper Colville River drainage. Moose may also be displaced from riversides during times of heavy air or ground traffic, resulting in reduced availability to hunters.

In addition to large land mammals, furbearers, such as wolf and wolverine, may avoid areas of heavy traffic, drilling noise, seismic testing, and other activities, affecting their availability to subsistence users. ROPs E-23, H-1, H-2, H-4, K-4, and K-15 would require consultation with potentially affected communities or landowners regarding the timing, siting, and methods of development, including seismic and open water activities. ROP F-4 places restrictions on the timing, location, and altitude of aircraft, in addition to requiring consultation with subsistence users, which would help reduce air traffic-related impacts.

Impacts on marine mammals from noise and traffic have also been reported by whaling crews and marine mammal hunters in Nuiqsut, Utqiaġvik, and Wainwright (SRB&A 2009a, 2017b); biological science also shows that marine mammals are sensitive to such disturbance. Utqiaġvik and Wainwright whaling crews and seal hunters hunt offshore from the NPR-A, while Nuiqsut whaling crews hunt to the east of the NPR-A, from Cross Island. Nuiqsut seal hunters hunt offshore, from the northeastern portion of the NPR-A in Harrison Bay.

Oil and gas development in the NPR-A would likely require increased barge and vessel traffic and potential construction of barge landings or gravel islands in order to support onshore development. Whaling crews have reported skittish behavior in bowhead whales and other marine mammals during times of heavy air and vessel traffic and seismic exploration. Such activity can divert bowhead whales farther from shore or cause unpredictable behaviors, resulting in greater risks to hunter safety (SRB&A 2009a, Galginaitis 2014).

If conflict avoidance agreements between industry and the Alaska Eskimo Whaling Commission continue in relation to the proposed oil and gas leasing program and barging activities, then impacts on whaling from increased barging and vessel traffic are unlikely; however, not all vessel traffic, such as that from barging not associated with oil and gas development, is subject to conflict avoidance agreements , so impacts from shipping and other activities could occur, even with a conflict avoidance agreement in place. conflict avoidance agreements are generally considered an effective measure by whaling crews, industry, and agencies (SRB&A 2013a). Conflict avoidance agreements would apply to the spring and fall whaling seasons and would not occur for the entirety of the marine mammal hunting season, which primarily occurs in the coastal NPR-A communities from April (spring whaling) through September; thus, NPR-A-related barge and vessel traffic may disrupt seal hunting outside the primary whaling season due to skittish behavior in the vicinity of vessels.

ROPs K-4, K-5, H-1, and H-4 provide a number of requirements and restrictions to marine vessel traffic and associated activities when in the vicinity of whales, walruses, polar bears, and seals, in addition to restrictions near important habitat areas. They also would help reduce potential conflicts with subsistence users, resources, and offshore activities. While most impacts on marine mammal hunting would occur in the summer, in association with offshore vessel and barge traffic, it is possible that onshore seismic activities could affect springtime (March/April) seal hunting for Nuiqsut, Utqiaġvik, and Wainwright and spring bowhead whale hunting in Utqiaġvik and Wainwright. Overall, because most development would be land based and because conflict avoidance agreements would reduce potential impacts associated with barging, impacts on resource availability may occur in isolated instances for individual hunters; however, they are not expected to occur for the community as a whole.

Noise and traffic associated with future oil and gas development and other activities within the NPR-A would also potentially disturb other subsistence resources, such as birds and fish, and could temporarily reduce harvesting success for NPR-A harvesters; however, most displacement would be temporary and would not change overall population levels (**Section 3.3.4** and **Section 3.3.5**). Noise and Rolligon traffic associated with seismic surveys in leased and unleased areas could cause flow alterations, thus blocking fish passage.

In addition, underwater shock waves could disturb, injure, or kill fish in winter (**Section 3.3.4**). During winter, residents from Utqiaġvik, Atqasuk, and Wainwright fish through the ice at rivers in the NPR-A.

Depending on the location of seismic surveys, these individuals could experience decreased fishing success from seismic activities, as has been reported in other communities (SRB&A 2009a). Reduced catch rates resulting from the use of seismic air guns have been documented by Engas, Lokkeborg, and Soldal (1996) and Engas and Lokkeborg (2002). Spring geese hunting could be affected if ice road and/or seismic activities continue into May.

Summer eider hunting could be affected by barge traffic, although disturbances to eiders from vessel traffic would likely be temporary and local.

Disturbances to birds and fish have been reported by Nuiqsut harvesters as a result of the Alpine Satellite Development and other developments and activities on the North Slope; however, such disturbances have not resulted in overall reductions in harvests of these resources over time (SRB&A 2009a). ROPs C-5, E-2, E-6, and E-13 would address some disturbances to fish habitat from seismic activity, exploratory drilling, construction, and infrastructure development.

The above impacts on resource availability may be considered localized from a biological standpoint; however, such small changes can have larger impacts on subsistence harvesters when resources are not present in traditional hunting areas at the expected times and in adequate abundance. Residents may experience reduced harvest success, increased costs and time, and increased safety risks if resources are less available.

While potential impacts on resource availability related to noise and traffic are most likely to be local, such as for the Atqasuk, Nuiqsut, Utqiaġvik, and Wainwright residents who use the planning area, more widespread changes in migration or abundance from noise and traffic and infrastructure could cause planning area-wide or regional impacts. Such impacts could extend throughout the NPR-A or outside the area to other communities, such as the peripheral and caribou study communities.

Summer activities that could affect caribou distribution or migration are helicopter, plane, and ground traffic along gravel roads; combined with impacts of infrastructure (see below) this could affect the timing or location of Western Arctic Herd or Teshekpuk Caribou Herd caribou arrival into subsistence harvesting areas to the south of the NPR-A during fall and winter. In addition, reduced harvests of caribou by NPR-A communities could disrupt sharing networks with other communities and regions if residents are unable to share as widely or frequently as they are accustomed to.

In addition to affecting resource availability, noise, traffic, and human activity may also affect user access by deterring subsistence users from their usual harvesting areas. Avoiding subsistence use areas due to development has been documented in Nuiqsut (SRB&A 2018b) and would likely occur for Utqiaġvik, Atqasuk, Wainwright, and Point Lay harvesters, if oil and gas or infrastructure development occurs in their harvesting areas. Residents may experience discomfort hunting in the presence of outsiders; they may avoid hunting near areas of high air or ground traffic because of a perceived or actual reduction in the availability of subsistence resources. Also, they may avoid hunting near human activity due to safety concerns or may consider noise pollution and increased human activity to degrade the subsistence experience.

Infrastructure

Infrastructure associated with oil and gas exploration, development, and production, in addition to other non-oil and gas infrastructure projects, could include future gravel and ice roads, pipelines, gravel pads, bridges, gravel mines, and runways. While most potential impacts related to infrastructure would be site-specific or local, occurring in and around action areas, certain impacts—particularly those related to caribou migration and abundance—could extend outside the NPR-A area and would be regional. Infrastructure impacts would be long term.

Infrastructure could cause loss of subsistence use areas for Atqasuk, Nuiqsut, Point Lay, Utqiaġvik, and Wainwright, due to direct overlap (**Appendix T, Maps T-3** through **T-6**). While oil and gas infrastructure is most likely to be built in areas of high hydrocarbon potential and subsistence use areas for Nuiqsut and Utqiaġvik, other community infrastructure could occur elsewhere in the NPR-A, affecting subsistence use areas for other communities.

Much of the area of high hydrocarbon potential shows moderate to high overlapping use by the communities of Nuiqsut and Utqiaġvik; Nuiqsut areas of moderate to high overlap are to the east and southeast of Teshekpuk Lake (**Appendix T, Map T-4**), and Utqiaġvik areas of moderate to high overlap are to the south and west of Teshekpuk Lake (**Appendix T, Map T-6**). Atqasuk use areas generally are to the west of the areas of high hydrocarbon potential but encompass most of the area of medium hydrocarbon potential (**Appendix T, Map T-3**).

While actual infrastructure would likely be limited to a smaller proportion of the overall development area, areas excluded from subsistence use would likely be greater than the actual footprint, either due to avoidance or security and firearm restrictions. In Nuiqsut, 48 percent of harvesters have reported avoiding development activities or infrastructure at one time or another from 2013 to 2017 (SRB&A Forthcoming). During individual study years, the percentage of respondents avoiding areas for development reasons has ranged from 31 percent to 46 percent. Data indicate a decrease in the use of certain areas, such as Nigliq Channel, which is attributed to development and other factors (SRB&A Forthcoming).

The community of Nuiqsut is now surrounded to the east, north, and west by oil and gas infrastructure, which contributes to a perception of being boxed in by development, with decreased access to traditional lands. Development of road, pipeline, and other linear infrastructure could present a barrier (either perceived or actual) for residents of NPR-A communities when accessing inland hunting or harvesting areas. Infrastructure would pose physical obstructions to subsistence users if roads and pipelines are not designed to account for overland hunter travel, or if bridges and causeways obstruct travel along rivers or coastlines. Some residents in Nuiqsut have reported difficulty safely crossing certain gravel roads with snowmachines or four-wheel-drive vehicles due to the steep side slopes (SRB&A 2018b).

Residents throughout the NPR-A frequently travel by boat in coastal areas and along rivers, searching for caribou and other resources. Pipelines or roads in coastal areas or in the vicinity of navigable waterways could affect residents' hunting activities if they are unable to shoot inland, due to the presence of pipelines or roads. Such impacts are particularly likely if pipelines are within 1 or 2 miles of coastlines or rivers. Such obstructions may also occur in the vicinity of roadways if residents use them to access hunting areas. ROPs E-1, E-4, E-5, E-7, and E-24 would help minimize potential direct obstructions to subsistence uses from infrastructure; however, impacts to access may still occur due to some harvesters avoiding industry.

If residents have access to roads associated with the oil and gas leasing program, or if additional infrastructure projects result in the construction of roads connected to local communities, it is likely that some would use the roads to access subsistence harvesting areas. Use of roads would be particularly likely when overland snowmachine travel is difficult and for residents who do not have access to overland modes of travel, such as snowmachines and four-wheel-drive vehicles. Use of these roads would be less likely or frequent if the roads are not connected to the local communities or are connected only seasonally via ice roads; in addition, use of roads for subsistence would likely decrease with distance from the communities.

The use of roads for subsistence activities can introduce benefits to subsistence users as has been show in the case of Nuiqsut (SRB&A 2018b); examples of benefits associated with roads include facilitating access to areas at times when access is difficult, such as during spring breakup, providing access for community residents who do not own snowmachines, four-wheel-drive vehicles, or boats, and allowing residents to access unavailable resources when they are closer to the community.

Roads connecting North Slope communities could also increase competition between communities in traditional hunting areas by concentrating harvesters into corridors and changing the dynamic of community use area patterns. Changes in harvesting and hunting patterns as the result of the introduction of roads has been documented in Nuiqsut and in other areas of Alaska (SRB&A 2018b, 2009b, 2007). The use of roads can facilitate access to areas not easily accessible during certain times of the year and provide access for individuals who do not have other overland or riverine means of travel, such as boat and snowmachines; even so, roads can also result in a shift in use toward road-accessible areas and away from other traditional hunting and harvesting areas. Reduced use of certain traditional harvesting areas or methods could reduce opportunities to pass on knowledge to younger generations regarding these places and uses.

If roads in the planning area are constructed but restricted to local access, then they would increase the magnitude and likelihood of impacts on user access and resource availability for NPR-A subsistence users. ROP H-3 would prohibit hunting, trapping, and fishing by lessees, operators, and contractors when personnel are working; however, this would not apply once workers' shifts end and they return to a public airport or community, such as Deadhorse.

Similar to noise, traffic, and human activity, infrastructure could also affect the availability of certain resources through changes in resource abundance, migration/distribution, and behavior. Infrastructure would be most likely to affect migratory terrestrial resources, particularly caribou, but could also affect moose in the southern portion of the NPR-A, furbearers, waterfowl, and fish. Infrastructure could divert or impede caribou movement and displace moose from riparian habitats in the vicinity of roads, waterfowl from nesting and other habitat, and fish from nearshore or riverine habitats, at least temporarily.

Studies on the North Slope show that caribou distribution, especially cows with calves, changes around transportation corridors and that approximately 30 percent of caribou are influenced in their movement by the presence of roads (NRC 2003; Wilson et al. 2016). Displacement of approximately 2.49 miles has been observed at existing North Slope oil fields; similar displacement levels would be expected in the NPR-A, although the potential for hunting along road corridors and the lower habituation of the Western Arctic Herd and Teshekpuk Caribou Herd, compared with the Central Arctic Herd, may result in greater displacement distances (**Section 3.3.5**). A road connecting Nuiqsut to Utqiaġvik, if routed north of Teshekpuk Lake, could displace a substantial number of Teshekpuk Caribou Herd caribou and affect users of that herd (**Section 3.3.5**).

Future development in the areas of high, medium, and low oil and gas potential, or other community infrastructure development, could present obstacles to caribou migrating in the spring and fall, affecting their arrival in traditional hunting areas at the expected times. Among the primary subsistence study communities, most of them harvest from both the Western Arctic Herd and the Teshekpuk Caribou Herd, although some rely more on one herd than the other; for example, Nuiqsut residents primarily harvest from the Teshekpuk Caribou Herd and the Central Arctic Herd, which occurs infrequently in the NPR-A. Anaktuvuk Pass residents have a particularly strong reliance on caribou due to their unique inland location and have observed how development infrastructure can affect caribou and the resulting availability for their community:

> *Pipeline has really changed our caribou hunting because Porcupine Herd used to cross the river, cross the road this way and come out to our Anaktuvuk and Anaktuvuk Valley from east, it doesn't happen no more. Once they build a road up here from -- from Alpine area to -- all the way across to NPR-A, once they build a road it's going to change the subsistence just like every one of those coastal villages, if they build a road that's going to change their subsistence* (Anaktuvuk Pass) (BLM 2003).

Residents hunt the Teshekpuk Caribou Herd during the summer, when the animals congregate along coastal and riverine areas and during their fall migration to southern wintering grounds. The Western Arctic Herd is also hunted in the NPR-A after calving, when caribou move into the western North Slope for insect relief and subsequently disperse across the North Slope and into the eastern Brooks Range foothills near Anaktuvuk Pass (Braem, Kaleak, Koster, Leavitt, Neakok, Patkotak, Pedersen, and Simon 2011); thus, depending on the location of infrastructure in the NPR-A, caribou harvesting from both the Teshekpuk Caribou Herd and Western Arctic Herd could be affected during the summer and fall, with some impacts extending into the winter. Because areas of high hydrocarbon potential overlap a greater portion of the Teshekpuk Caribou Herd range, including their primary calving ground, harvesters may be more likely to experience impacts on resource availability of the Teshekpuk Caribou Herd from oil and gas and other development and infrastructure.

While infrastructure is not expected to divert caribou migration altogether, linear features occurring perpendicular to migratory routes could slow caribou movement through the area, further reducing their availability to hunters along the coast (NRC 2003, Wilson, Parrett, Joly, and Dau 2016) (see **Section 3.3.6**). Temporary deflections of caribou in the NPR-A from roads have already been observed by Nuiqsut hunters, who indicate that caribou tend to hesitate on reaching the Colville Delta-5 and GMT1 roads and are less available in areas closer to the community (SRB&A 2018b). Road avoidance is particularly likely during times of high human activity, including ground vehicle use.

In addition, pipelines have been shown to influence caribou movements when they are parallel to primary migratory movements, which could affect subsistence users crossing into hunting areas and their hunting success. Deflections and delays of Western Arctic Herd caribou have been documented in the vicinity of the DeLong Mountain Transportation System road, although similar responses were not documented for the Teshekpuk Caribou Herd near the DeLong Mountain Transportation System (Wilson et al. 2016). Wilson et al. (2016) found that the DeLong Mountain Transportation System influences the movements of approximately 30 percent of radio-collared Western Arctic Herd caribou, and the average delay in crossing was 33 days. Other caribou displayed no response, crossing without delay.

Future oil and gas and other infrastructure development in the planning area is expected to result in long-term loss and alteration of bird habitat; however, these changes are not expected to cause overall changes in bird populations (**Section 3.3.5**). Infrastructure could affect fish habitat by causing habitat loss, increased turbidity from dust and gravel spray, reduced fish passage, and reduced water quantity (**Section 3.3.4**).

Seismic trails, ice roads, and other infrastructure may damage vegetation, at least in the short term, affecting the availability of subsistence plant and berry species in certain areas (**Section 3.3.1**). In addition, invasive non-native plants could be transported into the planning area along roads and could reduce availability of native species of plants and berries in those areas.

According to **Section 3.3.5**, future oil and gas infrastructure in the planning area, particularly in the Teshekpuk Caribou Herd calving grounds near Teshekpuk Lake and Western Arctic Herd calving grounds in the Utukok River Uplands, could cause a shift in calving distribution during some years with caribou using alternative calving habitats of lower quality; this would likely reduce calf survival and halt herd growth. To the extent that calving grounds are disturbed by oil and gas development, Western Arctic Herd and Teshekpuk Caribou Herd calf survival and herd numbers could be reduced. An overall reduction in the Western Arctic Herd or Teshekpuk Caribou Herd could affect harvest success among the Iñupiat on the North Slope, as well as other study communities within the range of these herds. Depending on the extent of current and future oil and gas and infrastructure development, the magnitude of these impacts could be large (**Section 3.3.5**).

Contamination

Real or perceived contamination, including that from oil spills, fugitive dust, transport of waste and hazardous materials, erosion, and air pollution, could affect resource availability and user access. If an oil spill reduces the abundance or health of certain resources, then those resources could become less available to the subsistence users. Contamination could occur during exploration, development, production, and abandonment and reclamation, or during construction and operation of community infrastructure projects. Depending on the nature of the contamination, it could be site-specific or local and either short or long term. If migratory resources are affected, contamination impacts could extend to a regional level.

Dust deposition from gravel infrastructure, ground traffic, and construction could affect fish habitat in the long term (**Section 3.3.4**), thus affecting the availability of fish in certain traditional harvesting areas for NPR-A harvesters. Fish are harvested in numerous river and lake systems across the NPR-A. Vegetation harvests may be affected by dust deposition along roads, and caribou may ingest contaminated vegetation in the event of small-scale spills along roadways (**Sections 3.3.1** and **3.3.6**). Potential impacts on resources from oil spills would occur for marine and riverine resources, such as fish, seals, and bowhead whales, in addition to bird and terrestrial resources that frequent riverine and marine areas. Small spills in the planning area or air contamination (either real or perceived) could also cause subsistence users to avoid harvesting certain resources, particularly near development areas. This could have indirect effects on human health through reduced consumption of nutritional foods (**Section 3.4.12**).

Depending on the location and magnitude of oil and gas and other infrastructure development in the NPR-A, impacts on fish availability could occur throughout harvesting areas for the NPR-A communities; however, most impacts on fish availability are not expected to extend throughout the NPR-A, unless a large-scale contamination event occurred. Iñupiat traditional knowledge, as explained by an individual, has observed the sensitivity of fish to various forms of contamination, and how even smaller forms of contamination can have effects on fish availability:

> *And the only biggest problem I have with that is you have 3 million gallons of gray water you dump on the ground now. And when you look at 3 million gallons of, you know, sewage and dish wash water, and you leave it on the ground, it gets pretty dangerous for the fish. The ground is very flat. We live in a flat ground and all the water that is put on top of the surface goes to the rivers. It works its way to the rivers and to the lakes. When I was young and being taught how to fish by my uncle up at the Chipp River, one time one of us washed our hands in the dish wash basin with soapy water and we went down to the river and rinsed our hands in the river and for 24 hours we never got fish in our nets that day just from rinsing our hands in the river. That's how sensitive that Aanaaklliq that we catch, that white fish we eat. And you're looking at dumping 3 million gallons of gray water on the ground?* (Utqiaġvik) (BLM 2004a)

While unlikely, large spills on land could affect waterfowl nesting areas and kill large numbers of birds (**Section 3.3.5**). It also could affect their availability to harvesters in other regions, such as to the south of the planning area.

In addition, vegetation harvesting areas would be affected by spills and contamination along roads, waterways, and in coastal areas. Finally, large-scale oil spills in open water associated with vessel or barge traffic, particularly during the summer, could have negative effects on large numbers of marine mammals, thus affecting the availability of these resources to Nuiqsut, Utqiaġvik, and Wainwright residents; however, the likelihood of a large-scale spill occurring is small (see **Section 3.3.6**).

Potential impacts from contamination are most likely for residents of Nuiqsut and Utqiaġvik, as they have the most documented use of areas of high hydrocarbon potential; however, impacts could also extend to other communities, such as Atqasuk and Wainwright, if oil and gas development extends into areas of medium hydrocarbon potential or if other infrastructure projects are in their traditional lands.

Most contamination events would occur in the NPR-A and so would result in local to planning area-wide effects; however, in the event of a large-scale oil spill in the marine or riverine environment or other contamination event, subsistence users who harvest resources that use or pass through the NPR-A, such as those from the peripheral or caribou study communities (see *Affected Environment*), may also experience reduced resource availability. This would be due to physical contamination or avoidance of resources from the perception that resources are contaminated; thus, impacts related to contamination would be of local to regional context. Monitoring air quality and contaminants in subsistence foods (ROPs A-9, A-10, and A-11) and comprehensive waste management plans (ROP A-2) would help address subsistence user concerns related to contaminants and would help to identify potential human health issues.

As stated in **Sections 3.4.3** and **3.4.12**, there is a low likelihood of contamination of subsistence food sources associated with pre- and post-leasing activities, with the exception of contamination through an oil spill. While a large-scale spill associated with oil and gas development in the planning area is considered unlikely, smaller contamination events may contribute over time to the perception that resources that use the planning area are contaminated or unsafe to eat. This may result in residents avoiding the planning area or such resources as caribou, marine mammals, and waterfowl, that migrate through the planning area and are later harvested elsewhere.

Avoiding subsistence foods due to contamination concerns is well documented. In a recent study on the North Slope, around half of community households in Nuiqsut and Kaktovik and one-quarter of community households in Point Lay and Wainwright reported having avoided eating certain subsistence foods during the previous year, due to concerns that they were contaminated (SRB&A 2017b).

Legal or Regulatory Barriers

Legal or regulatory barriers, including restrictions on access and firearm discharge near oil and gas facilities and other infrastructure, would occur throughout the life of any oil and gas or other infrastructure project and would reduce user access and resource availability in traditional use areas. Associated impacts would be site-specific or local and long term or short term, depending on the nature of the barrier, for example a pipeline or road versus temporary construction activity. Hunters would likely be subject to certain restrictions regarding discharging firearms near pipelines, roads, and other facilities. Depending on the parameters of such restrictions, such as the distance at which a firearm can be discharged, subsistence users could have difficulty hunting in certain areas, particularly where pipelines or roads parallel the coast.

Miscommunication surrounding rules and restrictions around future oil and gas facilities and unpleasant interactions with oil field workers, as has been documented in the case of Nuiqsut (SRB&A 2018b), may dissuade residents from accessing development areas. Impacts related to legal or regulatory barriers are most likely to occur for communities that use areas of high hydrocarbon potential (Nuiqsut and Utqiaġvik); however, it could occur for other NPR-A communities (Atqasuk, Wainwright, and Point Lay) if development expands into areas of medium or low hydrocarbon potential. ROPs H-1 and H-2 would require consultation with residents to facilitate access by subsistence users to areas of activity or facilities and to notify communities of upcoming industry activities.

Employment and Revenue

Increased employment and revenue related to future oil and gas and other infrastructure development could have positive and negative impacts on subsistence uses in affected communities and occur during the exploration, development, and production phases. Employment and revenue impacts would extend to a regional context and be long term. Increased income from employment and corporation dividends would likely be put to use in supporting subsistence activities through the purchase of faster and more efficient equipment and technologies and through supporting super-harvester households[11] in the community. Data on North Slope subsistence uses show that community engagement in subsistence activities has remained strong, alongside significant social and economic changes over the past several decades, such as higher household incomes (SRB&A 2017b, Kofinas, BurnSilver, Magdanz, Stotts, and Okada 2016).

Despite the relative persistence of subsistence harvesting, data for some North Slope communities also show a relatively high percentage of households that report low food security and no correlation with household income or harvest levels. In terms of harvest and income levels, there is a great diversity among village households, from high income/high harvest to low income/low harvest. These households show different levels of social connections, such as sharing ties, depending on harvest and income levels; thus, certain households may be less able to adapt to changing conditions and may be more vulnerable than others (Kofinas et al. 2016). Social connections are an important mitigation in the absence of household assets, such as income and harvest equipment, through sharing and cooperation; disruption of social connections could thus increase vulnerability in communities.

A potential increase in employment could cause a shift in subsistence roles in the community, as employed individuals may have less time to engage in subsistence activities (see **Section 3.4.4**). These potential impacts would be most likely to occur for Nuiqsut, which is already connected to oil and gas developments in the region, and Utqiaġvik, which is the economic center of the North Slope and would likely be connected to any future road system across the NPR-A (see **Section 3.4.11**, Economy). These communities would be most likely among North Slope village residents to see an increase in employment and income from the proposed oil and gas leasing program, unless development extends into areas of medium and low hydrocarbon potential; in this case, Atqasuk and Wainwright could also see an increase in employment and income.

Increased employment and income related to community infrastructure projects could occur for any of the NPR-A communities. Increased income from the Arctic Slope Regional Corporation (ASRC) and village corporation dividends could extend throughout the North Slope and would therefore be of regional context. Increased state royalties would also increase the amount of money being made to communities that are

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[9] Households with an abundance of able-bodied labor who are able to become the centers of subsistence production and distribution for a community.

eligible to receive funds from the NPR-A Impact Mitigation Fund, including Nuiqsut, Utqiaġvik, Atqasuk, Wainwright, and Anaktuvuk Pass. Increased mitigation funds could help offset some of the impacts on subsistence.

General Development and Culture

Overall, future infrastructure, oil and gas development, and other activities in the NPR-A area could have lasting effects on cultural practices, values, and beliefs through its impacts on subsistence. The potential impacts of development could result in reduced harvests, changes in uses of traditional lands, and decreased community participation in subsistence harvesting, processing, consuming, sharing, and associated rituals and feasts. Because of this, communities could experience a loss of cultural and individual identity associated with subsistence, a loss of traditional knowledge about the land, damaged social and kinship ties, and effects on spirituality associated with degradation of the NPR-A. While most general development and cultural impacts would be long term and at a planning area-wide context, certain impacts if affecting migratory resources could extend to a regional context.

Sharing is a key Iñupiat value and occurs through social and kinship networks that extend across various regions of Alaska. Two recent studies that address sharing among North Slope communities identified strong sharing networks between the North Slope and multiple other regions of Alaska, including the northwest, southwest, interior, southeast, and southcentral regions, in urban areas, such as Fairbanks and Anchorage, and to other states (SRB&A 2018a, Kofinas et al. 2016).

Kofinas et al. (2016) analyze different scenarios of change, including loss of harvestable resources, harvest shortfalls, changes in resource distribution/harvester access, increased costs associated with hunting, and employment, and the potential ramifications to village social and sharing networks. They note that households and communities are resilient to change, in large part because of the existence of complex sharing networks that allow for some flexibility in household roles and annual harvests; however, larger disruptions to subsistence, such as a community-wide harvest shortfalls, could "have disproportionately negative community-wide effects on distribution as high harvesters redistribute more food on aggregate." Such effects could extend outside communities as well, particularly between communities with strong sharing ties.

On a household level, Kofinas et al. (2016) suggest that certain households, such as those with fewer social connections and less income, are more vulnerable to changes in subsistence because they have less adaptive capacity with which to weather reduced resource availability or income; thus, some households may experience the impacts of NPR-A development more acutely than others, particularly during times of economic transition.

The various impacts on subsistence from development can weaken social cohesion over time through reduced participation in subsistence activities, including hunting, processing, and sharing and loss of connection to traditional camps, cabins, and subsistence use areas. (See **Section 3.4.4** for a discussion of potential effects related to social cohesion.) ROP I-1 would require cultural training for oil and gas personnel on environmental, social, traditional, and cultural concerns. Proper education may reduce the potential for conflicts between subsistence users and visiting workers.

Climate Change

The effects of climate change described under the *Affected Environment*, above, are part of the baseline conditions for subsistence uses and resources in the project area. See **Section 3.2.1** for a detailed discussion of the alternatives' contributions to global climate change.

Alternative A

Under Alternative A, the types of potential impacts on subsistence uses and resources would be the same as those described under *Impacts Common to All Action Alternatives*, above. The duration of all types of impacts would be long term, although certain specific impacts, such as those from seismic activity and construction noise, would occur only during the exploration and construction phases of individual development plans. Potential direct impacts on resource availability, resource abundance, and user access from noise, traffic, and human activity, infrastructure, contamination, and legal or regulatory barriers would occur primarily for communities in or with subsistence uses of the NPR-A, including Atqasuk, Nuiqsut, Point Lay, Utqiaġvik, and Wainwright.

Potential indirect impacts on resource availability and resource abundance resulting from noise, traffic, and human activity, infrastructure, and contamination would occur for communities in the NPR-A but would extend outside the NPR-A to other North Slope communities, such as Anaktuvuk Pass, communities with peripheral uses of the NPR-A (see *Affected Environment*), and the 42 communities that have documented uses of the Western Arctic Herd and Teshekpuk Caribou Herd.

Under Alternative A, management of the NPR-A would continue as previously approved under the February 2013 NPR-A IAP ROD. Approximately 52 percent of NPR-A lands would be available for oil and gas leasing and infrastructure development, with large portions of land protected for surface resources. Currently proposed projects such as GMT2 (under construction) and Willow (undergoing the NEPA process) would proceed, and reasonably foreseeable projects, such as development at Umiat and Smith Bay, may also proceed although the Smith Bay development would require substantial infrastructure development to support it, and Alternative A would limit onshore infrastructure in the vicinity of Smith Bay. The Teshekpuk Lake area would remain closed to development. Seismic surveys and exploration would likely continue throughout NPR-A oil and gas leases. Additional activities associated with community infrastructure projects, scientific and agency research, seismic surveys in unleased areas, and recreational activities would continue to occur throughout the NPR-A.

Under Alternative A, a large area of high hydrocarbon potential between Teshekpuk Lake and Smith Bay and along Ikpikpuk River would continue to be closed to oil and gas leasing, in addition to areas of medium hydrocarbon potential surrounding the highly used Dease Inlet, Admiralty Bay, and Chipp and Ikpikpuk rivers; thus, direct impacts on key Utqiaġvik and Atqasuk subsistence harvesting resulting from subsistence disruptions and interactions with nonresident workers and outsiders would be relatively unlikely. This would be the case unless oil and gas development occurs in areas of medium hydrocarbon potential to the south and southwest of the community or in areas of high hydrocarbon potential farther to the southeast of Utqiaġvik near Umiat, which is a key furbearer hunting and trapping area for Utqiaġvik.

Under Alternative A, Atqasuk would have the greatest percentage of use areas open to oil and gas leasing (71 percent), followed by Utqiaġvik (33 percent), Wainwright (29 percent), Nuiqsut (26 percent), Point Lay (10 percent), and Anaktuvuk Pass (less than 1 percent) (**Table 3-35**); however, most use areas for Wainwright, Atqasuk, and Point Lay have low to medium hydrocarbon potential.

Table 3-35
Percentage of NPR-A Subsistence Use Areas Closed and Open to Fluid Mineral Leasing

Community	Alternative A		Alternative B		Alternative C		Alternative D		Percentage of Total Use Areas in NPR-A
	Closed	Open[1]	Closed	Open	Closed	Open	Closed	Open	
Anaktuvuk Pass	3%	<1%	3%	<1%	0%	4%	0%	4%	4%
Atqasuk	25%	71%	36%	60%	4%	92%	1%	94%	100%
Utqiaġvik	28%	33%	29%	32%	16%	45%	12%	48%	62%
Nuiqsut	14%	26%	16%	24%	5%	35%	0%	40%	41%
Point Lay	29%	10%	30%	9%	29%	10%	29%	10%	40%
Wainwright	36%	29%	36%	29%	26%	39%	26%	39%	66%

Source: See **Appendix T**, **Table T-2**, Data Sources

[1] Open lands are those open to leasing, including those subject to NSO, controlled surface use, timing limitations, BMPs, and standard terms and conditions.

Because of their proximity to the planning area and the high potential for development in areas of moderate to high overlapping use, the communities of Nuiqsut and Utqiaġvik would be most likely to experience direct impacts associated with oil and gas leasing in the NPR-A; however, impacts could extend to Atqasuk, Wainwright, and Point Lay if development occurs in areas of low to moderate hydrocarbon potential. Atqasuk in particular could experience substantial impacts on subsistence if oil and gas leasing and subsequent exploration and development occur in areas of medium hydrocarbon potential.

Lands of high hydrocarbon potential to the west, southwest, and south of the community of Nuiqsut would remain open to oil and gas leasing under Alternative A; therefore, direct impacts on subsistence resource availability, resource abundance, and harvester access would continue to grow for Nuiqsut as oil and gas development expands into this area. In addition, positive and negative impacts on subsistence related to increased income and employment associated with oil and gas development would be most likely for Nuiqsut under Alternative A although all North Slope communities would likely benefit from increased revenue.

A large area of land surrounding Atqasuk would be open to oil and gas leasing under Alternative A, which represents a substantial portion of the traditional use area. Oil and gas leasing and development in this area could affect harvester access, resource availability, and resource abundance for this community and could lead to a situation similar to that seen in Nuiqsut, where the community is boxed in by development.

While nearly 30 percent of Wainwright lands would be open to oil and gas leasing, most of these lands would be in an area of low hydrocarbon potential and thus could experience impacts in the event that development extends into those areas. The area immediately around Wainwright and along the Kuk River, a key subsistence harvesting area for the community, would be closed to oil and gas leasing.

New infrastructure would be prohibited directly around Teshekpuk Lake and in the southwest portion of the NPR-A, but it would be allowable in most other areas of the NRP-A (**Table 3-36**). In the case of the primary study communities, Atqasuk would have the greatest percentage of its use area open to new infrastructure (65 percent), followed by Utqiaġvik (30 percent), Nuiqsut (27 percent), Wainwright (23 percent), Point Lay (8 percent), and Anaktuvuk Pass (less than 1 percent).

Community and other infrastructure projects, including roads, could occur throughout much of the NPR-A. North Slope communities, particularly Nuiqsut and Utqiaġvik, may experience impacts related to increased access for outsiders into the area and resulting subsistence competition and increased access by residents to subsistence harvesting areas via new roads. The lack of infrastructure surrounding Teshekpuk Lake would continue to minimize potential impacts on nesting waterfowl and calving caribou, thus reducing the potential for impacts on waterfowl and caribou availability and abundance to subsistence users on the North Slope and beyond.

Table 3-36
Percentage of NPR-A Subsistence Use Areas Closed and Open to Infrastructure

Community	Alternative A		Alternative B		Alternative C		Alternative D		Percentage of Total Use Areas in NPR-A
	Closed	Open[1]	Closed	Open	Closed	Open	Closed	Open	
Anaktuvuk Pass	4%	<1%	4%	<1%	<1%	3%	<1%	3%	4%
Atqasuk	27%	65%	47%	45%	25%	68%	25%	68%	100%
Utqiaġvik	30%	30%	37%	22%	24%	35%	23%	36%	62%
Nuiqsut	12%	27%	22%	17%	12%	27%	11%	29%	41%
Point Lay	31%	8%	32%	7%	31%	8%	31%	8%	40%
Wainwright	41%	23%	43%	21%	33%	32%	33%	32%	66%

Source: See **Appendix T**, **Table T-2**, Subsistence Data Sources

[1] Open lands are any lands available for new non-subsistence infrastructure. Lands that are unavailable for new infrastructure except for essential pipeline crossings, roads, or coastal infrastructure are not considered open.

Alternative B

The types of impacts from oil and gas leasing, post-oil and gas leasing activities, infrastructure development, and other activities in leased and unleased areas would be the same as those described under Alternative A and under *Impacts Common to All Alternatives*; however the likelihood and magnitude of impacts would be substantially less than those described under Alternative A. In short, of all alternatives, Alternative B would result in the least impact on subsistence uses.

Under Alternative B, the percentage of use areas open to oil and gas leasing would be similar to or slightly less than those under Alternative A for each community (**Table 3-35**); however, in the case of Nuiqsut, fewer acres would be in core subsistence use areas of moderate to high overlapping use. Impacts on Atqasuk, Utqiaġvik, and Wainwright would be similar to those discussed under Alternative A but with less potential for direct impacts near their communities.

Under Alternative B, the area closed to oil and gas leasing would extend farther to the east into the Fish Creek drainage, an area of key subsistence use for Nuiqsut. In addition, leases would be deferred for at least 10 years in an area bounded by the Colville River on the east, Harrison Bay on the north, and Umiat on the south. This area represents a substantial portion of the community of Nuiqsut's core hunting grounds for caribou, moose, fish, furbearers, and waterfowl. Deferring leases for 10 years would allow for continued monitoring of impacts on subsistence uses resulting from other relatively recent developments to the west of the Colville River, such as Colville Delta-5, GMT1, and GMT2. It also would allow greater analysis and understanding of subsistence impacts in order to inform decisions about future development within the community's traditional lands.

Alternative B would also restrict oil and gas leasing in the lands around and to the east of Atqasuk and to the east and south of Utqiaġvik. This would reduce the potential for direct impacts on subsistence resulting from oil and gas leasing and development. Alternative B would increase the area around most river and creek drainages that are subject to NSO, thus reducing concerns about impacts on fish and other resources from contamination and habitat degradation.

Because Alternative B would remove or defer a greater portion of the area of high hydrocarbon potential from oil and gas leasing, there would likely be less revenue from oil and gas revenue, especially in the short term; thus, there would be fewer positive and negative impacts on subsistence systems from increased income and employment.

Under Alternative B, a much larger area extending from Fish Creek in the east to the Admiralty Bay area in the west would be closed to infrastructure, in addition to numerous smaller areas in the central portion of the NPR-A; thus, Alternative B would reduce potential impacts on key subsistence harvesting areas and resources resulting from infrastructure. Substantially fewer acres of use areas for Atqasuk and Nuiqsut would be open to new infrastructure (**Table 3-36**).

Two north-south pipeline corridors would be provided for in the Teshekpuk Lake Special Area (**Appendix A**, **Map 2-6**) to allow for the transport of oil and gas from offshore leases. Some impacts on resource movement in the Teshekpuk Lake area may occur as a result of the pipelines, but these impacts would likely lessen over time as the caribou habituate to the presence of infrastructure (**Section 3.3.5**). Construction of a road linking Utqiaġvik and Nuiqsut under Alternative B would likely require substantial rerouting but would avoid core subsistence use areas for Nuiqsut and Utqiaġvik. Any road development under Alternative B would likely be rerouted past the community of Atqasuk and would therefore have greater impacts on that community in terms of disruption of subsistence activities.

Under Alternative B, the addition of 12 wild and scenic rivers in the southwestern portion of the NPR-A could reduce potential impacts on fish and other resources along key river systems, including the Kokolik, Utukok, and Colville rivers.

Alternative C

Under Alternative C, the number of acres available for oil and gas leasing would be higher than under Alternative A. Much of the areas open to oil and gas leasing between Atigaru Point and Utqiaġvik would be subject to NSO or timing limitations. Under Alternative C, the area of potential development would be substantially larger; therefore, the area of potential impacts related to harvester access and resource abundance and availability would be higher than that discussed under Alternative A. The percentage of subsistence use areas open to oil and gas leasing under Alternative C would be substantially higher for Atqasuk (92 percent of the subsistence use area), Utqiaġvik (45 percent), Wainwright (39 percent), and Nuiqsut (35 percent) (**Table 3-35**).

Alternative C would allow oil and gas leasing in the vicinity of a number of key subsistence drainages, including the Ikpikpuk, Chipp, Topagoruk, Meade, Inaru, and Kuk rivers, although areas surrounding these drainages would be subject to NSO. Still, concerns about impacts of oil and gas development in these areas and potential contamination of key subsistence drainages would likely be high among subsistence users in the NPR-A. A single pipeline corridor would be provided for in the Teshekpuk Lake Special Area (**Appendix A**, **Map 2-7**) to allow for the transport of oil and gas from offshore leases, so some impacts on resource movement in the Teshekpuk Lake area may occur.

The area open to infrastructure development under Alternative C would be similar to that described under Alternative A, but with a larger area open to infrastructure development in the southwestern portion of the NPR-A along the upper Colville River. This area is primarily used for furbearer hunting by North Slope communities, in addition to some peripheral uses by Anaktuvuk Pass and communities farther south. Development of infrastructure in this area could increase the likelihood of impacts on furbearer availability along the upper Colville River drainage.

The area is also somewhat closer to the Western Arctic Herd calving grounds and could therefore have a greater potential for introducing impacts on the Western Arctic Herd. The larger area available for oil and gas leasing in areas of high oil and gas potential may result in increased income and employment opportunities, which could have both positive and negative impacts on sociocultural systems.

Alternative D

Under Alternative D, the number of acres available for oil and gas leasing would be higher than under Alternative A, and the highest of any alternative. The only areas completely closed to mineral leasing would be in the western portion of the NPR-A in areas of low oil and gas potential. The percentage of use areas open to oil and gas leasing would also be higher for Atqasuk (94 percent of use areas), Utqiaġvik (48 percent), Nuiqsut (40 percent), and Wainwright (39 percent) (**Table 3-35**). As with Alternative A, most rivers would be subject to NSO, in addition to the area directly surrounding Teshekpuk Lake.

In general, oil and gas leasing could occur throughout much of the NPR-A under Alternative D, with various river drainages and lakes subject to NSO. The area north of Teshekpuk Lake and surrounding Admiralty Bay would be subject to controlled surface use, and a large area extending from Atigaru Point, south of Teshekpuk Lake, west toward Meade River, would be subject to timing limitations. Under Alternative D, a larger area around Teshekpuk Lake would be available for new infrastructure, and the percentage of use areas open to new infrastructure would be somewhat higher than under Alternative A (**Table 3-36**). Alternative D could result in substantial displacement of caribou from calving areas, affecting caribou survival and productivity and reducing the abundance and availability of this resource for subsistence users, particularly users of the Teshekpuk Caribou Herd. The higher potential for oil and gas and infrastructure development under Alternative D would increase the likelihood of impacts on subsistence resulting from noise, traffic, and human activity; infrastructure; contamination; legal and regulatory barriers; and employment and revenue. In short, Alternative D would have the most impacts on subsistence uses.

Cumulative Impacts

The geographic area of analysis for subsistence uses and resources is all areas used within the NPR-A planning area for subsistence purposes, and the temporal scope is from the 1970s through 70 years after the ROD signing. Past, present, and reasonably foreseeable future activities, in combination with infrastructure development and oil and gas leasing, exploration, development, production, and abandonment/reclamation in the NPR-A, would increase the potential for impacts on subsistence resource abundance and availability, harvester access, and additional impacts associated with increased competition, costs and time, and cultural impacts. Existing impacts on subsistence from past actions are discussed under *Affected Environment*, above.

Development of the NPR-A would likely result in changes to resource abundance, resource availability, and user access for North Slope subsistence users of the NPR-A, for communities with peripheral uses of the NPR-A (Ambler, Kiana, Kobuk, Noatak, Noorvik, Selawik, and Shungnak), and for other communities, such as users of the Western Arctic Herd and Teshekpuk Caribou Herd, that use resources that migrate through the planning area.

To date, oil and gas development in the NPR-A is relatively new and confined to the northeastern portion of the NPR-A (Colville Delta-5, GMT1, and the under-construction GMT2). Infrastructure development is generally confined to community boundaries, with no permanent roads connecting communities aside from annual community winter access trails. The existing management plan, and any changes to it, would allow for continuing expansion of oil and leasing and development into a large area, most of which was previously undeveloped and which has been used primarily for subsistence and recreation. Under any of the alternatives, six communities have direct uses of the planning area, and an additional seven communities have documented peripheral uses of the planning area. These and other communities outside the NPR-A rely heavily on the Western Arctic Herd and Teshekpuk Caribou Herd, both of which calve in and use the NPR-A.

Most communities on the North Slope have traditional and cultural ties to the NPR-A are or use resources that migrate through the planning area. Most of these communities, in addition to those outside the NPR-A whose residents rely on resources that migrate through the NPR-A are rural, low-income communities not connected by roads that rely on subsistence to support their mixed economy. Development of the NPR-A would introduce impacts on resource availability for key resources, such as caribou, moose, furbearers, fish, marine mammals, waterfowl, and vegetation.

Reasonably foreseeable future projects on federal minerals in the NPR-A, as projected in the RFD, are discussed under direct and indirect impacts above. Other reasonably foreseeable activities include additional oil and gas development outside the NPR-A, such as the Nanushuk development in the Colville River region, continued development of Kuparuk and Prudhoe Bay, the Liberty Development in the Beaufort Sea, Beaufort Sea OCS lease sales, and development of a natural gas pipeline from the North Slope to Canada, Valdez, or Cook inlet. Other reasonably foreseeable infrastructure projects are new permanent and seasonal roads, airport and community infrastructure improvements, and continued and increased marine vessel traffic and air traffic associated with shipping, scientific research, and recreation and tourism activities and business in the region.

Future development of the planning area would further expand the developed area on the North Slope, which would contribute to impacts on subsistence resource abundance, resource availability, and user access for subsistence users across the region. Oil and gas and other development would result in the physical removal of traditional subsistence hunting and harvesting areas, in addition to decreased access to certain areas through security and access restrictions and through user avoidance of development areas.

Increased infrastructure and activity in and around the planning area and in offshore areas could contribute to residents feeling being boxed in by development, particularly for Nuiqsut; it has already reported feeling boxed in to the west, north, and east, with only the southerly direction relatively untouched by development and development infrastructure (BLM 2018, SRB&A 2018b). The overall area available for subsistence use would likely shrink over time due to the increasing presence of infrastructure and human activity in traditional use areas. While NPR-A subsistence users would adapt, to varying extents, to the changes occurring around them and may continue to harvest resources at adequate levels, their connection to certain traditional areas may decrease over time. As discussed in the following traditional knowledge observation, Iñupiat are aware of cumulative effects of development and the resulting shifts that can occur to a community's use areas,

> *...it's to look at what happened in Ukndu (ph) Bay in Kuparuk because that is a cumulative impact. The people of Nuiqsut don't use that area like they did in the past. And, you know, there is research that shows that. And what's happened there is going to happen here. So the people who use that area are fearful of that. So that is going to be an impact to all of us. You know, whether industry is very -- you know, you try to do it the right way, people aren't going to want to go hunting there. You might have access or the right to go hunting there but it's not -- you know, it's not going to be a favorable place because you let -- how many people from Nuiqsut want to go back and hunt in*

> *Kuparuk with all the pipeline, the roads, or go fishing near Alpine? You know, it's not a preferred place to go. And that's exactly what's going to happen in this area as well as -- the more it moves to the left, it's going to happen. And people are nervous about that, you know? People are. I hear people say, you know, I'm going to go out now before industry comes and enjoy it as much as they can before it comes to our area. So that, you know, I see that as something I want to have on record* (Utqiaġvik) (BLM 2004b; **Appendix Y**).

As noted above, increased development surrounding Nuiqsut, including development in the NPR-A, could contribute to existing concerns about being surrounded by development and losing connections to traditional harvesting areas (SRB&A 2017, 2009a). Subsistence use areas would likely continue to shift away from oil and gas development, which would result in long-term changes in subsistence use patterns. In addition, the increased existence of road corridors in traditional use areas could shift how residents access subsistence harvesting areas, such as via roads, but could also affect resource availability, particularly for those who choose not to use roads. Such changes, including increased use of roads, combined with changes in harvesting patterns and resource availability, have been documented elsewhere in Alaska (SRB&A 2007, 2009b).

Roads associated with development may introduce a positive impact of increased access for residents into areas previously inaccessible during certain times of the year. Nuiqsut residents use the roads connecting their community to the nearby Alpine and GMT developments, although road use declines with distance from community and density of development infrastructure (SRB&A Forthcoming); thus, the level of road use by communities may vary, depending on the location and presence of infrastructure.

Communities may also benefit from reduced subsistence costs associated with shipping and supplies. Impacts on resource availability may be most pronounced for communities that do not experience increased income associated with the oil and gas development, such as jobs or dividends, or those that do not experience benefits of the project related to lowered costs of subsistence supplies and equipment, food, or other goods. These communities would have less opportunity to purchase or invest in fuel and equipment to adjust to changes in access and resource availability. For example, if oil and gas development were to occur in areas of high hydrocarbon potential in the northeast portion of the NPR-A, and a road system were built between Utqiaġvik and Nuiqsut, residents of Atqasuk and Wainwright may experience impacts associated with the road system on caribou availability, without having the countervailing benefit of accessing the road to hunt.

This increased use of roads in the planning area could represent a countervailing beneficial impact on other potential negative impacts discussed in this section; however, roads would likely also result in impacts on harvester access and resource availability over time; thus, road access may help counteract the impacts of the roads themselves but would likely not eliminate those impacts on subsistence.

Over time, development and infrastructure projects would increase the area accessible to outsiders, including nonresident hunters, which could increase competition for locals. Roads would also facilitate higher levels of oil and gas activity and associated vessel, ground, and air traffic, seismic activity, gravel mining and blasting, and drilling.

Other similar activities, including shipping activity not subject to conflict avoidance agreements and research-related air traffic, would also continue and add to oil and gas related disturbances. Harvesters may adapt to such changes by increasing the amount of effort and time spent on the land, investing in more efficient means of travel, and shifting to new subsistence areas to increase harvest success rates.

Increased income among North Slope residents could help offset some of these impacts by providing cash to purchase fuel, equipment, and supplies for subsistence pursuits. Certain individuals, such as those who are low-income, those with limited time or modes of travel, or those who choose to avoid development (including roads), may be less able to adapt to changes in resource availability and harvester access.

Construction of additional roads and infrastructure in the future would contribute to fragment habitat for such resources as caribou, moose, furbearers, and waterfowl. Infrastructure would remove usable habitat for these resources and, in the case of caribou, could cause substantial changes in range distribution. Impacts on migrating caribou increase with density of roads and infrastructure (see **Section 3.3.6**); thus, it is likely that development of the NPR-A, a key calving and insect relief habitat for both the Western Arctic Herd and Teshekpuk Caribou Herd, would contribute to changes in caribou migration, distribution, and abundance, with resulting impacts on subsistence resource availability to communities that use these resources..

If the planning area eventually becomes open to public access, potential for impacts on local communities from increased competition and overall human activity would be much higher. Furthermore, infrastructure projects, including those additive impacts from the implementation of projects such as ASTAR, could result in greater public access to traditional hunting areas in the planning area, particularly on the North Slope. If roads, ROWs, or reclaimed ROWs increase access to the planning area, State and federal regulators may respond by introducing stricter hunting and harvesting regulations as well, which would affect the availability of resources to local communities.

Increased competition and decreased resource availability may result in residents having to travel farther and spend more time, money, and effort to harvest such resources as moose and caribou. Development of the planning area, in combination with future oil and gas development in surrounding onshore and offshore areas, increased marine, ground, and air traffic, and construction of new infrastructure projects, would likely reduce the availability of certain subsistence resources, such as caribou, sheep, moose, small land mammals, fish, waterfowl, or vegetation.

If these projects reduce resource availability for subsistence study communities or if they decrease access to traditional use areas, then residents may have to spend greater amounts of time, effort, and money in order to locate and procure these resources. Residents may also have to travel farther to less familiar areas to find resources, with greater risks to health and safety, which may be compounded by similar impacts related to climate change (see *Affected Environment*). While some hunters respond to changes in resource availability by taking more trips and increasing costs in order to harvest what they need, others may choose to take fewer trips because of lack of funds or reduced success.

Nuiqsut residents have shown adaptability to the changes around them and continue to harvest subsistence resources at rates similar to before; however, despite continued harvests, residents stress that the frequent disturbances to subsistence activities, loss of connection to traditional use areas from oil and gas infrastructure, and increased time and effort spent harvesting continue to affect their overall subsistence way of life (SRB&A 2017).

As development continues to grow around the community, it remains to be seen if, or for how long, the community of Nuiqsut would be able to continue adapting to the changes occurring. If changes in resource availability occur on a larger scale as a result of the leasing program, such as changes in migration or overall abundance of the Central Arctic Herd or Teshekpuk Caribou Herd, then communities farther away could experience greater net impacts on subsistence. This would be the situation particularly for those with a high reliance on these herds, who would not experience increased economic activity and revenues from the increased development.

Ultimately, cumulative impacts on subsistence could alter subsistence use areas, user access, and resource availability for subsistence users. When subsistence users' opportunities to engage in subsistence activities are limited, then their opportunities to transmit knowledge about those activities, which are learned through participation, are also limited. If residents stop using portions of the planning area for subsistence purposes, either due to avoidance of development activities or reduced availability of subsistence resources, the opportunity to transmit traditional knowledge to younger generations about those traditional use areas would be diminished.

While communities would likely maintain a cultural connection to these areas and acknowledge them as part of their traditional land use area, the loss of direct use of the land could lead to reduced knowledge for the younger generation of place names, stories, and traditional ecological knowledge associated with those areas.

There would also be fewer opportunities for residents to participate in the distribution and consumption of subsistence resources, ultimately affecting the social cohesion of the community. Any changes to residents' ability to participate in subsistence activities, to harvest subsistence resources in traditional places at the appropriate times, and to consume subsistence foods could have long-term or permanent effects on the spiritual, cultural, and physical well-being of the study communities. This would come about by diminishing social ties that are strengthened through harvesting, processing, and distributing subsistence resources and by weakening overall community well-being. For an additional discussion of potential cumulative impacts on sociocultural systems, including culture and belief systems, see **Section 3.4.4**.

Thus far, communities on the North Slope have adapted to the changes around them and have maintained a strong subsistence identity; however, this is not to say they have not experienced impacts on subsistence hunting activities, loss of subsistence use areas, and social effects, and there could be a point where residents are no longer be able to adapt to such changes. The continued maintenance of subsistence traditions would depend on the continued availability of subsistence resources and the continued ability of subsistence users to access resources, particularly if there are changes in resource abundance, distribution, or migration.

Alternatives that allow the greatest amount of land to be leased and developed would have the greatest potential contribution to cumulative effects on subsistence uses and resources. This is because they would have a greater effect on resource availability, resource abundance, and user access; thus, Alternative D would have the largest potential contribution to cumulative effects on subsistence uses and resources, followed by Alternative C and Alternative A. Alternative B would have the smallest potential contribution to cumulative effects on subsistence uses and resources and would reduce potential impacts over the current management plan.

3.4.4 Sociocultural Systems

Affected Environment

This section describes the affected environment for sociocultural systems potentially affected by the BLM's proposed revisions to management policies for the NPR-A planning area. It provides a brief overview of sociocultural systems among the Iñupiat, including history, social/political organization, the mixed cash/subsistence economy, and belief systems, with an emphasis on the communities closest to the planning area: Anaktuvuk Pass, Atqasuk, Nuiqsut, Point Lay, Utqiaġvik, and Wainwright. Additional associated information that is relevant to sociocultural systems is in **Sections 3.4.2**, **3.4.3**, **3.4.11,** and **3.4.12**.

This section also tiers off a more detailed description of sociocultural systems provided in the 2012 NPR-A IAP Final EIS (BLM 2012) and in **Appendix U**. While this affected environment focuses on current sociocultural systems among the Iñupiat, additional discussion of traditional sociocultural systems and how these systems have changed over time is provided in **Appendix U**, **Section U.1**.

History

A discussion of the history of the NPR-A planning area, particularly in the context of the Iñupiat, who have inhabited the planning area for thousands of years, is provided in **Appendix U**, **Section U.1**. A discussion of the prehistory of the NPR-A planning area is in the 2012 NPR-A IAP Final EIS (BLM 2012; **Section 3.4.2**).

Social and Political Organization

Iñupiaq social organization traditionally revolved around the bilateral family unit and extended kin, in addition to trading partnerships and friendships (Hall 1984). The political organization of Iñupiaq societies also revolved around the family unit; however, one role in particular exerted the most political influence, that of the *umialik*. Besides the *umialik*, there were several other positions that served political and other functions. These positions included that of the *umialik*'s wife (*nuliaqpak*), a specialized hunter or foreman (*ataniq*), and a religious shaman (*angatquq*) (Chance 1990; Burch 1980).

Following European and American contact, the social and political organization of the Iñupiat changed. These changes were a result of such factors as compulsory education, which led to the centralization of people into permanent villages; introduction of modern technologies, which altered residents' methods for harvesting and processing subsistence foods; the introduction of a cash economy; the introduction of Christianity; and incorporation of the Iñupiat into new systems of laws and governing systems (Chance 1990).

Over the past century, the traditional Native political organization has been replaced by a formalized system of State, federal, and other organizations that is unlike the traditional political organization. Alaska Natives have in many ways adapted to the new political system through the establishment of Native entities; examples are local governments, such as state municipalities and boroughs, Native Villages, and Indian Reorganization Act Councils; economic profit corporations, such as Indian Reorganization Act corporations, cooperative associations, ANCSA corporations; nonprofit development and service corporations; and multi-regional political organizations, such as the Alaska Federation of Natives and Alaska Native Brotherhood.

Despite the changes in social and political organization over time, the core of Iñupiaq social organization is similar on the North Slope today; it encompasses not only households and families, but also wider networks of kinship and friends and individual family groups, who depend on the extended family for support. The sharing and exchange of subsistence resources strengthen these kinship ties. The Iñupiat continue to uphold certain traditional social roles, such as those of the whaling captains, whaling crew members, and whaling captains' wives. Six North Slope communities, including Kaktovik and Nuiqsut, are members of the Alaska Eskimo Whaling Commission and have local Whaling Captains Associations.

Other important subsistence roles are found with certain households or individuals who play a particularly important role in harvesting subsistence resources and distributing them to households and individuals who are unable to hunt or harvest for themselves. These "super-harvester" households have been identified through previous Alaska Department of Fish and Game research, which found that 30 percent of households generally harvest 70 percent of the total community harvest (Wolfe 2004).

Mixed Cash/Subsistence Economy

The Iñupiat traditionally participated in an economy that relied on subsistence resources and used trade to acquire goods not readily available in their immediate area. The economy of the North Slope underwent major changes beginning in the mid-nineteenth century, when commercial whaling introduced a new type of economy to the Iñupiat. It was followed by other economic developments, such as reindeer herding, fur trapping, and petroleum development.

Today, North Slope communities have a mixed subsistence-market economy, where families invest money into small-scale, efficient technologies to harvest wild foods (Walker and Wolfe 1987). Native corporation dividends rely heavily on oil and gas development, and many residents use their dividends as investments into their subsistence way of life. The trade networks that characterized the traditional subsistence economy of the Iñupiat continue today. They are a major component of the mixed economy and have been facilitated by advancements in rural transportation and technology (SRB&A 2018a).

Cultural Values and Belief Systems

The introduction of Christianity in the late nineteenth and early twentieth centuries and the subsequent establishment of Western social and political institutions altered a number of Iñupiaq cultural values, traditions, and belief systems. Those particularly affected were housing, morality, spirituality, subsistence, and social organization (Burch 1974; Chance 1990); however, despite the changes, the Iñupiat of the North Slope today retain a strong cultural identity associated with traditional subsistence hunting and harvesting patterns, and many traditional belief systems are strongly held.

Contemporary Iñupiaq values strongly mirror traditional ones; examples are respect for nature, humility, love and respect for elders, cooperation, hunting traditions, knowledge of language, and family and kinship (NSB 2018). Cultural values are inextricably linked with all facets of Iñupiaq life, including education, government, and business; however, none more so than subsistence hunting and harvesting traditions (SRB&A 2018c).

Maintaining and passing down cultural values, including knowledge of subsistence hunting and harvesting methods, traditions, and places, is of utmost importance to North Slope residents (BLM 2012). Coastal North Slope communities maintain a strong maritime culture that centers on the bowhead whale hunt and emphasizes cooperation, participation in hunting traditions, and sharing. The caribou hunt is another key tradition among both coastal and interior North Slope communities; residents view the entire NPR-A as an important habitat and hunting ground for this valuable resource. Anaktuvuk Pass, in particular, relies on caribou for most of its subsistence harvest. For additional discussion of subsistence uses in the planning area, see **Section 3.4.3**.

Sharing is central to the Iñupiaq world view and one of the core values of their culture and society (NSB 2018). Sharing serves to maintain and strengthen social ties within and across communities. Customary practices like *Kivgiq* (the Messenger Feast) and *Nalukataq* or *Qagruq* (the spring Whale Festival) exemplify the interconnectedness of subsistence hunting and sharing in and beyond the community. Researchers (Kofinas, BurnSilver, Magdanz, Stotts, and Okada 2016; SRB&A 2018a) have recently documented the expansive sharing networks between and among Alaska Native communities today, including those on the North Slope.

Iñupiaq people continue to identify with the places of their ancestors and return to these places to hunt, fish, camp, gather, and process wild foods. The Iñupiaq people's relationship to the land is characterized by these subsistence traditions, in addition to stories and place names associated with places, trails and travel routes, and landmarks (SRB&A 2018c); thus, to the Iñupiat, protecting traditional lands and waters and the wild resources that inhabit them is essential to maintaining cultural traditions, knowledge, and identity.

Today, the Iñupiat are continuously adapting and responding to various forces of change that challenge their ability to protect these lands and waters and that contribute to social stress within communities.

Existing Impacts on Sociocultural Systems

Past and present actions that have affected sociocultural systems among the Iñupiat are oil and gas development, onshore and offshore transportation and infrastructure projects, scientific research, increased recreation and tourism, demographic changes, land status changes, government regulations, modernization, and climate change.

North Slope Iñupiat have experienced the impacts of development on their social organization since their initial contact with European explorers in the nineteenth century. The traditional social structure, which was based around extended kinship ties, trading partnerships, and friendships, underwent numerous changes throughout the nineteenth and twentieth centuries, for example the centralization of residents into permanent communities through mandatory education; the introduction of modern technology and changes to the traditional subsistence-based economy through the introduction of a cash economy; and the incorporation of Native peoples into new systems of laws and governing systems. More recent changes have come from the following

- Degradation of traditional lands from development
- The creation of wildlife refuges and national parks and resulting restrictions on traditional uses
- Government hunting and harvesting regulations
- Recreation and sport hunting and fishing activities
- Scientific research and associated activities, including research associated with oil and gas development
- Transportation corridors (including the Dalton Highway and marine highway systems)
- Climate change

Today, oil and gas development on the North Slope is a primary source of impacts on social organization among the Iñupiat, especially for the community of Nuiqsut, which is now connected to the Alpine development via a year-round road. Economic benefits associated with oil and gas development are another major driver of change on the North Slope. While oil and gas development has brought increased revenue, which has contributed to infrastructure development and social services on the North Slope, increased income opportunities and disparities have also introduced tensions within and among communities, such as the lack of shareholder status for certain community members.

Climate Change

Climate change affects sociocultural systems by reducing or increasing the availability of certain subsistence resources, reducing access to traditional harvesting areas at suitable times of the year, reducing harvester safety, and resulting in the loss of cultural sites and traditional camps and cabins through erosion and other changes to the physical environment. These impacts are discussed in further detail under **Sections 3.4.2** and **3.4.3**. Impacts of climate change include changes in the predictability of weather conditions, such as the timing of freeze-up and breakup, snowfall levels, storm and wind conditions, and ice conditions, such as ice thickness on rivers and lakes. All of these affect the Iñupiat's abilities to travel to subsistence use areas when resources are in those areas.

In addition, subsistence users may experience greater risks to safety when travel conditions are not ideal. Changes in resource abundance or distribution from climate change can also affect the availability of those resources to subsistence users; they also may cause subsistence users to travel farther and spend more time and effort on subsistence activities (Brinkman 2016). Changes in travel conditions from a greater frequency of storms and thinner ice can put hunters at greater risk to safety when traveling by boat or snowmachine; this could ultimately lead to injury or death (**Section 3.4.12**).

Direct and Indirect Impacts

Issuing oil and gas leases in the NPR-A, as permitted under any BLM management plan, would have no direct impacts on the environment. This is because, by itself, a lease does not authorize any on-the-ground oil and gas activities; however, a lease does grant the lessee certain rights to drill for and extract oil and gas, subject to further environmental review and reasonable regulation, including applicable laws, terms, conditions, and stipulations of the lease.

The impacts of such future exploration and development that may occur from issuing leases are the potential indirect impacts of leasing. Such post-lease activities could include seismic and drilling exploration, development, production, and transportation of oil and gas from the NPR-A. The management plan may also permit or restrict other activities, such as gravel mining and infrastructure development, such as roads and pipelines, in certain areas; therefore, this analysis is of potential direct and indirect impacts on sociocultural systems from on-the-ground post-lease activities, mining, and infrastructure development in the NPR-A.

As described in the previous section, Iñupiaq sociocultural systems are based on social and kinship ties, subsistence harvesting, and a deep connection to the land and its resources. Oil and gas development in the planning area would likely affect sociocultural systems by introducing changes to traditional subsistence lands and resources; the social, health, and cultural environment; and local and regional economies.

This section identifies potential sociocultural impacts on sociocultural systems of the North Slope Iñupiaq, in addition to other subsistence users of resources that occur in the NPR-A and are harvested elsewhere. The effects of climate change described in the *Affected Environment* above could influence the rate or degree of the potential direct and indirect impacts.

Impacts Common to All Alternatives

This section discusses potential impacts on sociocultural systems from potential actions under an updated NPR-A IAP, as follows: oil and gas leasing, exploration, development, production, and abandonment and reclamation; sand and gravel mining; other infrastructure development; and the establishment of special area boundaries (see **Chapter 2**). These systems are common to all alternatives.

The primary factors that may result in impacts on sociocultural systems are 1) changes in income and employment levels, 2) changes in available technologies, 3) disruptions to subsistence activities and uses, 4) and an influx of nonresident temporary workers and other outsiders associated with post-lease oil and gas activities and infrastructure development. Additional more general impacts on sociocultural systems resulting from development in traditional lands are discussed, where applicable, throughout the impact discussion.

Many of the Lease Stipulations and ROPs, designed to reduce potential impacts on subsistence uses and resources (see **Section 3.4.3**) and cultural resources (see **Section 3.4.2**), would also help reduce sociocultural impacts. ROP I-1 and the required orientation program would also help, with the goal of increasing oil and gas company personnel's sensitivity and understanding to community values, customs, and lifestyle in potentially affected areas. Personnel would be trained to comply with local and corporation drug and alcohol policies. Most sociocultural effects, both positive and negative, would affect the NPR-A communities of Atqasuk, Nuiqsut, Utqiaġvik, and Wainwright, throughout the program area; however, a number of sociocultural effects could extend beyond the NPR-A to the North Slope communities of Point Lay and Anaktuvuk Pass or, in some instances, to subsistence users from other regions. The specific communities and regions that could be affected are discussed below for the various types of effects. The duration for sociocultural effects would be long term, lasting longer than 5 years.

Changes in Income and Employment Levels

Increased income and employment levels could affect sociocultural systems by changing the socioeconomic status of certain community members, reducing the time spent by certain individuals on harvesting subsistence resources, thus affecting social ties in the community, and increasing the amount of cash available to engage in subsistence activities and support subsistence-related equipment and infrastructure.

An influx of cash into a small, rural community can have both positive and negative impacts on sociocultural systems. Traditional Iñupiaq societies are based on social and kinship ties, which are established and strengthened through the procurement, processing, consumption, and sharing of subsistence resources (see *Affected Environment* above). Increased income from employment or revenue may also be associated with some increase in alcohol and drug use (**Section 3.4.12**).

Certain households or individuals play a particularly important role in harvesting subsistence resources and distributing them to households and individuals who are unable to hunt or harvest for themselves. Super-harvester households were identified through previous Alaska Department of Fish and Game research, which found that 30 percent of households generally harvest 70 percent of the total community harvest (Wolfe 2004). Recent research indicates that harvests may be even more concentrated for such resources as caribou (SRB&A [forthcoming]; Kofinas et al. 2016). An increase in employment opportunities may result in some of these households shifting away from their roles as super-harvesters because they lack the time to engage in subsistence activities as frequently as they once did. This could weaken or shift certain social ties in the community, and these changes could be long term.

While a shift in subsistence roles could cause social stresses in a community, Kofinas et al. (2016) note that the role of super-harvester households often changes over time, sometimes from year to year, and that communities are relatively resilient to these changes; some households increase their contribution to the harvest in some years in response to others decreasing their contribution. In addition, the roles of super-harvester households and high-earning households are not mutually exclusive; in fact, Kofinas et al. (2016) found that many super-harvester households are high-income households, and most high harvesting households have at least one employed member.

Other research has shown an inverse relationship between income and harvesting levels, with high income associated with lower harvests (Guettabi, Greenberg, Little, and Joly 2016); thus, it is likely that some households may use an increased income to invest in subsistence technologies and increase their subsistence harvesting levels, while others may decrease their participation in the subsistence economy. That said, a sudden and substantial increase in employment and income may cause a more dramatic shift in the role of super-harvester households in the community, and it may take longer for the community to adjust to the changes.

During the initial period of post-lease development, there may be a decrease in super-harvester households, as job opportunities increase and new roles are established. As a result, the distribution of subsistence foods throughout communities could temporarily decline. If communities experience a dramatic change in the availability of key subsistence resources, such as caribou, there could be a point where residents would no longer be able to adjust to such changes. It is not possible, based on available data, to predict when or how such a point could occur; however, recent data comparing road-connected communities to non-road-connected communities have shown that road-connected communities have substantially lower subsistence harvests than non-road-connected communities (Guettabi et al. 2016).

In the analysis, road-connected communities are those in more densely populated areas and on publicly accessible roads. While roads associated with development of oil and gas reserves are not expected to be publicly accessible, other transportation and infrastructure projects that would be allowable under all alternatives could result in the construction of publicly accessible roads tying North Slope communities to the Alaska highway system. Making roads publicly accessible to North Slope communities could substantially increase access by nonresident hunters, increase access to store-bought goods, and have greater impacts on sociocultural systems for local communities. This would be the situation particularly for Nuiqsut and Utqiaġvik, which are most likely to have direct access to a road. The potential sociocultural impacts of such an occurrence would likely be negative and long term (Chapin, Folke, and Kofinas 2009).

In addition to super-harvester households, high earning households also play an important role in the subsistence economy. This is because they often provide financial support to subsistence harvesters in the community as well as in their own households. As noted above, super-harvester households can also be high-earning households. An increase in employment and income resulting from the proposed oil and gas leasing could therefore have potential positive effects on social ties, once community roles are established; however, increased income opportunities in a community can also cause greater potential income disparities between households, especially if certain households are not shareholders in the village or regional corporations. Such disparities can affect social relations and leadership roles in a community. In general, an increase in employment opportunities can strengthen residents' resolve to remain in their home communities rather than to move in search of employment. Subsistence activities have been shown to persist despite increased income and wage employment, which demonstrates that the importance of subsistence is not limited to its nutritional benefits (Kruse 1991).

Changes in income and employment associated with post-lease activities would have the most potential direct impact on the Iñupiaq community of Nuiqsut. This is because it would likely be closest to ongoing development in the NPR-A and may be connected to future developments via road; thus, Nuiqsut residents are most likely to obtain employment associated with development and support activities in the planning area.

If a proposed community road between Utqiaġvik and Nuiqsut is constructed, then the potential for changes to income and employment for Utqiaġvik residents would be higher. Increased income and employment may also extend to other Iñupiaq communities, such as Atqasuk and Wainwright, if oil and gas development expands into areas of moderate to low hydrocarbon potential; however, direct participation in oil and gas activities by North Slope residents would be relatively limited.

While multiple North Slope communities are in or next to the NPR-A, Nuiqsut is the closest community to the areas of high hydrocarbon potential, followed by Atqasuk, Anaktuvuk Pass, Utqiaġvik, Point Lay, and Wainwright. Utqiaġvik and Atqasuk are in areas of medium hydrocarbon potential. Jobs and job-related income associated with oil and gas development would likely be highest during the production phase. Jobs during the exploration and development phases would be seasonal, temporary, and fewer (**Section 3.4.11**). Similarly, jobs associated with infrastructure development would likely be temporary or seasonal. Levels of local employment would depend largely on the implementation of adequate local hiring policies and opportunities for NSB-based businesses and corporations.

On a regional scale, as shareholders of the ARSC and village corporations and through NSB revenues, Iñupiat communities across the North Slope may see increased economic activity from post-lease activities. They may also be exposed to a greater number of employment opportunities. By contrast, residents of other regions would likely see only modest economic activity and revenues associated with profit sharing from ASRC to their regional corporations. The comparative lack of economic activity for non-North Slope communities could make them vulnerable to social impacts, if post-leasing activities were to result in large-scale disruptions of subsistence activities, such as caribou hunting (see **Section 3.4.3**). If communities experience reduced harvests, increased reliance on store-bought foods could introduce financial hardships for certain households. Without the increased economic activity associated with development, communities are more vulnerable to its impacts and less able to adapt to environmental and social changes resulting from the development.

Changes in Available Technologies

Increased income and employment future oil and gas exploration, development, and production could also increase access to technologies, such as those for subsistence equipment and fuel. Access to such technologies could aid subsistence users in accessing subsistence harvesting areas, particularly if development results in subsistence users having to travel farther or spend longer to find and harvest subsistence resources.

Communities close to oil and gas development areas may also eventually have greater access to high-speed internet and strong cell phone reception. In recent years, greater use of and access to cell phones and social media has shifted how residents in and between communities communicate with one another. In some ways, it has expanded social ties by facilitating connections across regions of Alaska and encouraged the establishment of trading relationships.

Greater access to transportation and shipping options can also have a positive impact on sharing networks and the ability to bring goods directly into the community. Road corridors constructed for developing the planning area and community infrastructure could open up access for local hunters to subsistence areas not easily accessible or restricted during certain times of the year (see **Section 3.4.3**). In Nuiqsut, construction of road corridors associated with development of Colville Delta-5 and GMT1 increased the use of those corridors by residents for subsistence hunting, although preliminary data indicate that use of roads decreases with distance from the community and density of development infrastructure. In particular, residents who do not have access to boats or overland modes of travel, such as four-wheel-drive vehicles and snowmachines, and residents who have limited time due to job and other commitments benefit from the presence of roads (SRB&A 2018b).

Some individuals have increased their participation in subsistence activities due to the increased access to hunting areas. In contrast, other hunters have decreased their use areas surrounding roads to avoid industry and because of their personal preferences against road hunting. Data also show a possible shifting away from traditional use areas to areas west of the community where the road systems have increased access (SRB&A Forthcoming); thus, access to roads may increase subsistence opportunities for many hunters and possibly increase overall participation in hunting; however, road access may also result in changes to traditional harvesting patterns and avoidance by certain individuals. Such changes would be most likely for Nuiqsut and Utqiaġvik because of their proximity to high potential areas and the likelihood of road projects connecting these two communities; however, the changes could extend to Atqasuk and Wainwright if oil and gas development were to extend into areas of medium to low hydrocarbon potential.

Disruptions to Subsistence Activities and Uses

Subsistence activity disruption associated with future oil and gas activities could indirectly affect social cohesion. As noted above, increased income and employment levels could change social ties and organization by causing certain individuals and households to shift to new roles that are less focused on subsistence production. Such impacts would be highest during the production phases of individual developments when the number of available permanent jobs would be highest; thus, impacts from disrupting subsistence activities and uses would likely go through phases of higher intensity as individual oil and gas developments occur. To the extent that development in the planning area disrupts subsistence or reduces the availability of certain resources to subsistence harvesters, residents may either experience reduced harvests of subsistence foods or spend greater time, effort, and expense in pursuit of subsistence resources (see **Section 3.4.3**).

Potential impacts on subsistence resources availability would likely occur throughout the life of post-leasing activities in the NPR-A. They are most likely to affect terrestrial and riverine resources, such as caribou, moose, furbearers, fish, and waterfowl. While the NPR-A includes onshore areas only, development of offshore areas, such as the Smith Bay reservoir, would require developing onshore infrastructure, such as pipelines and barge landings. In addition, onshore development in the NPR-A would likely require the development of barge landings and storage pads or gravel islands, such as the one currently proposed for the Willow development.

Increased infrastructure in the offshore environment, in addition to increased vessel traffic associated with development of the NPR-A, could affect marine subsistence uses, such as fishing and hunting for marine mammals, such as seals and bowhead whales. Most social impacts of disrupting subsistence activities would be on the North Slope communities, whose traditional use areas would be subject to oil and gas leasing, exploration, development, and production, and infrastructure development. Nuiqsut and Utqiaġvik have the greatest potential for social impacts. This is because most areas of high hydrocarbon potential are in the northeast portion of the NPR-A, between Teshekpuk Lake and Colville River, both key subsistence harvesting areas for those communities.

If oil and gas or infrastructure development occurs in other areas of the NPR-A, such as those with low or medium hydrocarbon potential, then other North Slope communities, such as Atqasuk, Point Lay, or Wainwright, could experience direct impacts at similar levels to those experienced by Nuiqsut and Utqiaġvik. If development of the NPR-A results in more substantial changes to resource migration, distribution, or abundance, then impacts could extend outside the NPR-A to Anaktuvuk Pass and other communities whose residents have peripheral uses of the NPR-A—Ambler, Kiana, Kobuk, Noatak, Noorvik, Selawik, and Shungnak—or who harvest from the Western Arctic Herd or Teshekpuk Caribou Herd (see **Section 3.4.3**)

Impacts would be lowest during the leasing phase, when activity levels would be minimal; impacts would increase throughout the exploration and construction phases. During the development and production phases, disruptions to subsistence activities in the way of noise and traffic would be lower; however, impacts related to infrastructure would be higher. Nuiqsut residents have reported impacts on resource availability associated with nearby developments, but they continue to harvest resources at levels similar to before; however, continued harvests do not equate to an absence of impacts.

Residents report adapting to changes in resource availability by shifting to new hunting areas, spending more effort and time on the land, or changing hunting methods, such as hunting caribou along newly introduced road corridors. Changes in caribou migration and distribution or reduced harvests among North Slope communities and a corresponding decrease in sharing caribou meat to other regions could result in residents spending more time and effort hunting for caribou and traveling farther, with a greater risk to hunter safety (**Section 3.4.3**).

An inability to harvest adequate subsistence resources can have negative social consequences for a community. Decreased harvests of subsistence resources—particularly key resources, such as caribou, fish, and marine mammals, such as bowhead whales, seals, and walruses—in turn decreases the number of opportunities for participation in such activities as processing, consuming, and sharing subsistence foods and culturally important feasts and festivals. These are all important in maintaining and strengthening social and cultural ties in the community.

While impacts on resource availability of bowhead whales would be somewhat unlikely as a direct result of NPR-A development, caribou, moose, furbearers, fish, and waterfowl availability may be affected for the communities that use the NPR-A (**Section 3.4.3**). Larger impacts on resource availability could have community- and region-wide effects on sharing networks, which could affect social ties if harvest shortfalls persist (**Section 3.4.3**).

The inability of subsistence harvesters to provide for their community can also have negative social, health, and nutritional consequences (**Section 3.4.12**). Residents have reported that during times of reduced harvest success, they have witnessed increased social problems, such as drug and alcohol use, particularly among younger subsistence hunters (SRB&A 2009). Introduction of new infrastructure and industrial traffic in traditional use areas and associated changes in subsistence travel routes and harvesting patterns could increase the risk of injuries and accidents during subsistence activities. This would have negative social effects (**Section 3.4.12**); however, these impacts would likely lessen over time as residents become accustomed to security policies and traveling in developed areas (**Section 3.4.11**).

Finally, decreased use of certain traditional areas can result in fewer opportunities for residents to pass on traditional knowledge about those places, weakening the cultural associations residents have with the land. This would be due to changes in resource availability and user access or the degradation of one's experience on the land resulting from noise and human activity. These impacts could extend to future generations.

Even in the absence of physical disruptions to the distribution or migration of Teshekpuk Caribou Herd and Western Arctic Herd caribou, real or perceived contamination or degradation of the NPR-A or the resources that inhabit it could have negative social and psychological effects on subsistence users due to the importance of the area to their cultural and spiritual identity. Examples of this are the sense of self, community, and efficacy and psycho-social well-being. See **Section 3.4.3** for a more detailed discussion of potential impacts on subsistence by community.

Influx of Nonresident Temporary Workers and Outsiders

Another potential source of impacts on sociocultural systems is an influx of nonresident temporary workers associated with future oil and gas activities into local communities and traditional use areas. Also, a general influx of outsiders into local communities associated with increased development would have impacts on the region. While interactions with nonresidents has become increasingly common in rural Alaskan communities, most Iñupiaq communities continue to be relatively remote and primarily Alaska Native. On the North Slope, the community of Utqiaġvik has the highest percentage of non-Native residents (**Appendix V, Table V-1**).

Interactions with nonresidents can sometimes cause discomfort for residents when they do not respect or understand local traditional values and customs. Residents have expressed discomfort conducting subsistence activities when nonresidents are around for fear that their traditions would be misinterpreted, misunderstood, or exploited for political purposes. Such concerns have become particularly prevalent in today's climate of social media posts, viral videos, and negative online backlash (Oliver 2017).

Witnessing nonresidents mistreating or disrespecting the land and its resources can also have negative cultural and spiritual impacts on locals, especially if the area holds particular importance to a community. In the case of the NPR-A, the area is in the core subsistence harvesting area for Atqasuk, Nuiqsut, Utqiaġvik, and Wainwright and, to a lesser extent, Point Lay. It is considered a key habitat for many resources that are harvested in and outside the North Slope, such as caribou, moose, furbearers, fish, and waterfowl.

The presence of temporary workers associated with post-lease exploration and development in traditional hunting areas could result in negative interactions between subsistence users and workers. This would be due to a lack of cultural understanding and respect on the part of the workers or miscommunication of policies and procedures surrounding use of the land by residents for hunting. The number of workers would be highest during the production phases of individual development (**Section 3.4.11**).

If future oil and gas activities facilitate or promote access to outsiders into Nuiqsut or Utqiaġvik or other communities for reasons associated with development or community infrastructure projects, potential impacts could include increased social problems, such as outsiders bringing in drugs and alcohol, lack of infrastructure to accommodate the increase in visitors, such as lodging and transportation, and conflicts resulting from lack of knowledge or respect of traditional values.

Native women and girls experience substantially higher rates of domestic and other violence than others. Oil and gas development in or near Native communities in the United States may raise this already high risk (Walker 2015). Because oil and gas workers would be housed at on-site camps for all stages of development, interactions between oil and gas workers and NPR-A residents would be minimal outside of the camps, and camp housing would have restrictions on drug and alcohol use (**Section 3.4.12**).

An increase in population associated with post-lease activities is not expected for the study communities; oil and gas workers are expected to stay in work camps and return to other areas of Alaska or outside Alaska (**Section 3.4.11**); however, it is possible that additional transportation infrastructure linking North Slope communities, such as Utqiaġvik and Nuiqsut, to other parts of Alaska would increase the likelihood of outsiders moving to these communities. In addition, it is possible that the communities closest to oil and gas development, such as Nuiqsut and Utqiaġvik, would experience an increase in visitors associated with the oil and gas industry and social and scientific research.

Climate Change

The effects of climate change described under the *Affected Environment*, above, are part of the baseline conditions for sociocultural systems in the project area. See **Section 3.2.1** for a detailed discussion of the alternatives' contributions to global climate change.

Alternative A

Sociocultural system impacts common to all alternatives are discussed in the previous section. Under Alternative A, management of the NPR-A would continue as previously approved under the February 2013 NPR-A IAP ROD. Under Alternative A, approximately 52 percent of NPR-A lands would be available for oil and gas leasing and infrastructure development, with large portions of land protected for surface resources.

Alternative A would retain Special Areas near Teshekpuk Lake, the Colville River, the Utukok River Uplands, Kasegaluk Lagoon, and Peard Bay, all of which are key wildlife habitats and subsistence use areas on the North Slope. Under Alternative A, a large area of high hydrocarbon potential between Teshekpuk Lake and Smith Bay and along Ikpikpuk River would continue to be closed to oil and gas leasing. This would be in addition to areas of medium hydrocarbon potential surrounding the highly used Dease Inlet, Admiralty Bay, and Chipp and Ikpikpuk rivers; thus, direct impacts on key Utqiaġvik subsistence harvesting from subsistence disruptions and interactions with nonresident workers and outsiders would be relatively unlikely. The exception would be if oil and gas development are in areas of medium hydrocarbon potential to the south and southwest of the community or in areas of high hydrocarbon potential farther to the southeast of the community near Umiat. This is a key furbearer hunting and trapping area for Utqiaġvik.

As noted in **Section 3.4.3**, Atqasuk and Wainwright would have the greatest percentage of subsistence use areas open to oil and gas leasing; however, most of these use areas have low to medium hydrocarbon potential.

Lands with high hydrocarbon potential to the west, southwest, and south of Nuiqsut would remain open to oil and gas leasing under Alternative A; therefore, direct impacts associated with subsistence disruptions and interactions with outsiders in key traditional use areas would continue to grow for the community of Nuiqsut as oil and gas development expands (see **Section 3.4.3**). Impacts on sociocultural systems related to increased income and employment associated with oil and gas development would be most likely in Nuiqsut under Alternative A, although all North Slope communities would likely benefit from increased revenue.

New infrastructure would be prohibited around Teshekpuk Lake and in the southwest portion of the NPR-A, but it would be allowed in most other areas of the NRP-A; thus, infrastructure projects such as roads could occur throughout much of the NPR-A. North Slope communities, particularly Nuiqsut and Utqiaġvik, may experience impacts and benefits related to increased shipping and transportation options, increased access for outsiders into the area, and increased access by residents to subsistence harvesting areas via new roads. Iñupiaq sociocultural systems would likely continue to experience impacts from ongoing development and associated activities, such as oil and gas development and research, infrastructure and transportation projects, changes to land status, environmental changes, and increased outsiders in traditional use areas.

The lack of infrastructure surrounding Teshekpuk Lake would reduce potential impacts on nesting waterfowl and calving caribou, thus reducing the potential for impacts on waterfowl and caribou availability and abundance to subsistence users on the North Slope and beyond.

Alternative B

The impacts from oil and gas leasing, exploration, development, production, and reclamation would be the same as those described under Alternative A, with some exceptions. Under Alternative B, the area closed to oil and gas leasing would extend farther to the east into the Fish Creek drainage, an area of key subsistence use for Nuiqsut. In addition, leases would be deferred for at least 10 years in an area bounded by the Colville River in the east, Harrison Bay in the north, and Umiat in the south. This area represents a substantial portion of the community of Nuiqsut's core hunting grounds for caribou, moose, fish, furbearers, and waterfowl (see **Section 3.4.3**); therefore, sociocultural impacts associated with subsistence disruptions and influx of outsiders would be delayed under Alternative B.

Alternative B would also restrict oil and gas leasing in the lands directly around and to the east of Atqasuk, directly to the east and south of Utqiaġvik, and directly around upriver of Wainwright. This would reduce the potential for direct impacts on sociocultural systems resulting from subsistence disruptions and increased interactions with nonresident temporary workers and outsiders.

Because Alternative B would remove or defer a greater portion of the area of high hydrocarbon potential from oil and gas leasing, there would likely be less oil and gas revenue under this alternative, especially in the short term; thus, there would be fewer positive and negative impacts on sociocultural systems associated with increased income and employment and changes in available technologies.

Under Alternative B, a much larger area, extending from Fish Creek in the east to the Admiralty Bay area in the west, would be closed to infrastructure, in addition to numerous smaller areas in the central portion of the NPR-A. Construction of a road linking Utqiaġvik and Nuiqsut under Alternative B would likely require substantial rerouting but would avoid core subsistence use areas for Nuiqsut and Utqiaġvik. Any road development under Alternative B would likely be rerouted past the community of Atqasuk and so would have greater impacts on that community by disrupting subsistence activities. In summary, Alternative B would have the fewest impacts on sociocultural systems.

Alternative C

Under Alternative C, the number of acres available for oil and gas leasing would be higher than under Alternative A. Much of the areas open to oil and gas leasing between Atigaru Point and Utqiaġvik would be subject to NSO or timing limitations. Under Alternative C, the area of potential development would be substantially larger; therefore, the area of potential impacts from disruptions to subsistence and interactions with nonresident temporary workers and outsiders would be higher than that discussed under Alternative A (see **Section 3.4.3**).

The area open to infrastructure development under Alternative C would be similar to that described under Alternative A, but with a larger area open to infrastructure development in the southwestern portion of the NPR-A along the upper Colville River. This area is primarily used for furbearer hunting by North Slope communities, in addition to some peripheral uses by communities farther south. The larger area available for oil and gas leasing in areas of high oil and gas potential may increase income and employment opportunities; this could have both positive and negative impacts on sociocultural systems (see **Section 3.4.11**). Alternative C would have greater impacts on sociocultural systems than Alternative A.

Alternative D

Under Alternative D, the number of acres available for oil and gas leasing would be the highest of any alternative. The only areas completely closed to mineral leasing would be in the western portion of the NPR-A, with low oil and gas potential. As with Alternative A, most rivers would be subject to NSO, in addition to the area surrounding Teshekpuk Lake. In general, oil and gas leasing could occur throughout much of the NPR-A under Alternative D, with various river drainages and lakes subject to NSO. The area north of Teshekpuk Lake and surrounding Admiralty Bay would be subject to controlled surface use. Also, a large area, extending from Atigaru Point, south of Teshekpuk Lake, and west toward Meade River, would be subject to timing limitations.

Under Alternative D, a larger area around Teshekpuk Lake would be available for new infrastructure. The higher potential for oil and gas and infrastructure development under Alternative D would increase the likelihood of impacts on sociocultural systems resulting from disruptions to subsistence, increased income and employment levels, increased interactions with outsiders, and changes in available technologies. Alternative D would have the greatest overall impact on sociocultural systems.

Cumulative Impacts

Past, present, and reasonably foreseeable future activities, in combination with infrastructure development and oil and gas leasing, exploration, development, production, and abandonment and reclamation in the NPR-A, would increase the potential for sociocultural impacts. The cumulative impacts time frame for analysis spans from the 1970s through full realization of the hypothetical development scenario (**Appendix B, Section F.3.1**), which is anticipated to occur approximately 70 years after the ROD is signed. This would include sociocultural changes in income and employment levels, changes in available technologies, disruptions to subsistence activities and uses, and increased interactions with outsiders. Existing impacts on sociocultural systems from past actions are discussed under *Affected Environment*, above.

Proposed and current activities affecting the study communities include additional or continued development of oil and gas resources in the onshore and offshore development. Reasonably foreseeable activities are as follows:

- SAExploration 3D seismic proposal
- Colville Delta-5, GMT2, Willow, and Nanushuk developments in the Colville River region
- Continued development of Kuparuk and Prudhoe Bay
- Liberty Development in the Beaufort Sea
- Beaufort Sea OCS lease sales
- Development of a natural gas pipeline from the North Slope to Canada, Valdez, or Cook inlet (the Alaska Stand Alone Gas Pipeline or Alaska LNG Pipeline)

Other reasonably foreseeable activities are additional infrastructure projects, including new permanent and seasonal roads; airport and community infrastructure improvements; continued and increased marine vessel traffic and air traffic associated with shipping, scientific research, and recreation, tourism, and business in the region. Infrastructure and oil and gas development in the NPR-A could also lead to or facilitate additional oil and gas development outside the planning area, such as in offshore areas, and other development and infrastructure projects.

All of these activities, in combination with development of oil and gas resources, infrastructure projects, and gravel resources in the planning area, would increase the potential for interactions between residents and nonresident workers, as well as the potential for conflicts in communities over their support for or opposition to these projects. Tensions between communities relating to differences in opportunities for increased economic activity, such as increased employment, and potential negative sociocultural impacts, such as disruptions to subsistence levels, could strain social ties and reduce social cohesion. Income disparities or political differences in and between communities could also contribute to social tensions between residents and community institutions.

Development could increase tensions between different community institutions in relation to disagreements about land jurisdiction and management and differing priorities and agendas, resulting in additional strains on social cohesion. If employment opportunities were to increase to the extent that fewer residents have the time to engage in subsistence activities, then overall community harvests and participation could decrease. This could weaken the community's identity and association with the subsistence lifestyle (see **Section 3.4.3**) and could reduce social cohesion and increase social problems. A positive impact of increased income through employment or dividends would be the incentive for residents to remain in their communities and provide financial support for subsistence activities there, thus strengthening the mixed subsistence cash economy.

The cumulative impacts of the past, present, and reasonably foreseeable activities on the economy are tied closely to cumulative impacts on subsistence. North Slope communities participate in a mixed subsistence-market economy. The increasing presence of development and infrastructure in and around study communities may disrupt its economic organization through changes in subsistence activities and participation in the cash economy. If subsistence activities or resources are disrupted to the extent that overall harvests of subsistence resources decline, then residents may begin to rely more heavily on wage employment and participate less in traditional subsistence activities.

Alternatively, increased income in the community, either through Native corporation dividends or wage employment, may introduce a positive impact. This would be the result of providing more people with opportunities to participate in subsistence activities, including residents who previously could not participate due to a lack of money to buy equipment or fuel.

Infrastructure resulting from projects that result in greater public access to traditional hunting areas in the planning area, particularly on the North Slope, could result in a greater potential for interactions with non-Natives, who may not share the same cultural values and respect for the land. Development of road and other infrastructure may, however, introduce a positive impact of reduced costs of goods and services for local communities. This could encourage residents to remain in their communities and continue to practice their subsistence lifestyle, while participating in the local cash economy.

Cumulatively, strong local economies could have positive social impacts as long as communities are able to adapt to such changes while maintaining cultural traditions and values. Examples of these traditions and values are subsistence, humility, respect for elders, family and kinship, and avoidance of conflict; however, while research has documented the resilience of subsistence-based economies, it has also made clear the vulnerability of rural communities to large-scale changes in subsistence resource availability, harvester access, employment levels, income, and road access, with road-connected communities having lower subsistence harvests, when compared with communities not connected by roads.

The cumulative impacts of past, current, and reasonably foreseeable actions on subsistence activities are discussed above, in **Section 3.4.3**. Subsistence activities are key to maintaining social ties in indigenous communities, so any disruption to the hunting, harvesting, processing, distribution, and consumption of subsistence resources would also affect social organization in the community.

The incremental construction of development-related infrastructure throughout traditional Iñupiaq hunting and harvesting areas and in areas of key importance to various migratory fish, waterfowl, and terrestrial mammal (caribou) resources could erode the identity or cultural connection with those lands. This impact has already occurred in traditional use areas or camps in existing development areas, such as the Prudhoe Bay and Alpine areas, which are no longer accessible or usable by residents.

Development of the planning area would likely change subsistence and social systems, particularly for the NPR-A communities of Atqasuk, Nuiqsut, Utqiaġvik, and Wainwright. If development of the planning area were to reduce calving success for the Western Arctic Herd and Teshekpuk Caribou Herd and cause an overall decline in the availability of caribou from those herds, then cumulative impacts on sociocultural systems could extend beyond the NPR-A to other North Slope study communities, such as Anaktuvuk Pass, Point Lay, and the caribou study communities listed in **Section 3.4.3**. This would be the result of direct changes in harvest success or reduced flows in sharing networks.

Future development of large-scale oil and gas development projects, such as Alaska LNG or Alaska Stand Alone Pipeline, in addition to the gradual increase in developed areas on the North Slope, such as further development of the Prudhoe Bay/Kuparuk oil fields in addition to the Alpine, GMT1 and GMT2, Nanushuk, and Willow developments, would contribute to impacts on migratory resources. Examples are habitat fragmentation win the Porcupine Caribou Herd, Central Arctic Herd, and Teshekpuk Caribou Herd ranges and an increase in the likelihood of disrupting subsistence harvesting of caribou and other migratory resources, such as waterfowl. If this were to occur, communities not experiencing increases in income or employment levels, such as Ambler, Kiana, Kobuk, Noatak, Noorvik, Selawik, and Shungnak, could be vulnerable to changes in subsistence harvests.

The development of offshore oil and gas resources in the Beaufort Sea, which could be facilitated by oil and gas and infrastructure development in the NPR-A, would result in greater disruption to marine harvesting activities for Nuiqsut and Utqiaġvik, thus adding to the cumulative effects on subsistence. The effects of climate change described under *Affected Environment*, above, could influence the rate or degree of the potential cumulative impacts.

Alternatives that allow the most land to be leased or developed in the planning area are likely to have the greatest potential contribution to cumulative effects on subsistence resource availability; therefore, they would have the greatest contribution to cumulative effects on sociocultural systems. This is because future post-lease activities would have a greater effect on subsistence uses and resources and the greatest likelihood of interactions with outsiders, while increasing regional or local economic activity; thus, Alternative D would have the largest contribution to cumulative effects on sociocultural systems, followed by Alternatives C and A; Alternative B would have the smallest contribution to cumulative effects on sociocultural systems.

3.4.5 Environmental Justice

Affected Environment

Executive Order 12898 directs federal agencies to identify and address the disproportionately high and adverse human health or environmental effects of their actions on minority and low-income populations, to the greatest extent practicable and permitted by law (see **Appendix V** for details about this Executive Order).

The study area for the environmental justice analysis includes 1) the three tiers of communities that utilize subsistence resources occurring in the planning area, as described in the **Section 3.4** introduction; and 2) all communities within the NSB except for Prudhoe Bay/Deadhorse. Prudhoe Bay/Deadhorse is not included because it is an industrial enclave, with all its population living in group quarters. Apart from Kaktovik, Point Hope, and Prudhoe Bay/Deadhorse, all communities within the NSB are Tier 1 communities.

In addition, the study area includes non-bounded communities. As per guidance in Council on Environmental Quality (CEQ 1997), in identifying minority and low-income populations, the environmental justice analysis considers as a community a geographically dispersed set of individuals who share a common direct or indirect effect on the human environment as a result of the proposed action.

Appendix V, **Table V-1** lists place-based study area communities identified as areas of potential environmental justice concern based on minority and/or low-income metrics. The only study area communities that did not meet the criteria are Fairbanks, Wiseman, and Bettles.

American Indians or Alaska Natives constitute a high proportion of most study area communities' total populations. Nearly all these individuals are Alaska Natives. **Appendix V**, **Table V-1** also shows that nearly all the study area communities are associated with federally recognized tribes, although the tribal entity cannot be considered identical to the city, town, or census-designated place in which the tribe is located. This is because some residents may be non-tribal members, and a separate city government may exist. The only communities not associated with federally recognized tribes are Fairbanks, Wiseman, and Bettles.

Communities in the study area with proportionally larger Alaska Native populations often have the highest poverty rates. Statewide, the average percentage of Alaska Natives living in poverty during the 2013–2017 period was higher than any other racial or ethnic group and more than three times that of whites (U.S. Census Bureau 2019). Generally, unemployment within the study area communities is high, with typical unemployment rates in the double digits (**Appendix V**, **Table V-1**). Most communities in the study area have "mixed" economies in which households rely on both cash income and the harvest of subsistence resources (**Section 3.4.4**). Cash-paying jobs tend to be temporary or seasonal in rural Alaska, so cash incomes tend to be small and insecure (ADFG undated). Due to the low availability of year-round jobs, together with the high cost of food in local grocery stores, subsistence is essential to some residents' diets (**Section 3.4.12**). Moreover, the environmental justice impacts related to potential adverse impacts on subsistence resources encompass the Alaska Native social and cultural value of subsistence resources and their uses, as described in **Sections 3.4.3** and **3.4.4**.

As noted above, the environmental justice analysis considers trans-geographic as well as place-based communities. Minority and/or low-income individuals who do not reside in areas of potential environmental justice may nevertheless share a common direct or indirect effect on the human environment. For example, Alaska Native households dispersed throughout more urbanized areas of the state may send contributions of money to hunters residing in North Slope communities and, in turn, receive a share of caribou meat that is shipped back to them (Kofinas et al. 2016). Consequently, the urban households and the North Slope communities would be affected by changes in the availability or abundance of the caribou resource in the planning area.

Climate Change

As noted by the BLM (2018), climate change can be understood as an environmental justice issue. People who live in poverty may be particularly vulnerable to the negative economic impacts of climate change because they have fewer financial resources to cope with these effects (EPA 2017a). Alaska Natives living in rural areas also may be especially vulnerable to climate-related effects due to their economic, nutritional, and cultural dependence on subsistence food resources (EPA 2017b). Often, conditions of poverty amplify adverse impacts on subsistence resource use. For example, if subsistence harvests decrease or subsistence-related travel costs increase, lower-income households may be unable to spend more money on fuel and other subsistence-related expenses, and they may be less able to shift to more expensive commercial food sources, thereby potentially experiencing decreased food security (BLM 2018a).

The Alaska Natives of northern Alaska and Interior Alaska are disproportionately affected by climate change, both by the fact that climate change effects are more pronounced in these regions and by the fact that subsistence activities in the two regions are particularly dependent on ice, wind, and permafrost conditions. Recent research utilizing Scenarios Network for Alaska Planning (SNAP) climate projection data reports that climate change is altering the environment of northern Alaska and Interior Alaska and affecting subsistence users' ability to access subsistence resources at appropriate times (Brinkman et al. 2016; SNAP 2019). The reduction of sea ice has exacerbated coastal erosion, the weather has become less predictable, the shore ice in spring is less stable for whaling, fall travel for caribou is hampered by a late and unreliable freeze up, spring hunting for geese is hampered by an early breakup, and ice cellars provide less reliable food storage. All these issues create significant concerns for many Alaska Natives because they are factors that cannot be controlled and that are threatening their way of life (Brinkman et al. 2016).

Direct and Indirect Impacts

The effects of climate change described under the *Affected Environment*, above, are part of the baseline conditions for environmental justice in the project area. See **Section 3.2.1** for a detailed discussion of the alternatives' contributions to global climate change.

This analysis of direct and indirect impacts related to environmental justice considers if implementation of the proposed alternatives would result in disproportionately high and adverse environmental or human health effects on the communities identified as areas of potential environmental justice concern in **Appendix V**, **Table V-1**. As directed by Council on Environmental Quality (CEQ 1997), the analysis considers the following factors when determining whether effects are disproportionately high and adverse:

1) Whether there is or will be an impact on the natural or physical environment that significantly (as employed by NEPA) and adversely affects a minority, low-income, or tribal population. Such effects may include ecological, cultural, human health, economic, or social impacts on minority, low-income, or tribal communities when those impacts are interrelated to impacts on the natural or physical environment.

2) Whether environmental effects are significant (as employed by NEPA) and are or may be having an adverse impact on minority, low-income, or tribal populations that appreciably exceeds or is likely to appreciably exceed those on the general population or other appropriate comparison group

3) Whether the environmental effects occur or would occur in a minority, low-income, or tribal population affected by cumulative or multiple adverse exposures from environmental hazards

The analysis of environmental justice is also informed by Council on Environmental Quality guidance, as follows:

> Under NEPA, the identification of a disproportionately high and adverse human health or environmental effect on a low-income population, minority population, or Indian [or Alaska Native] tribe does not preclude a proposed agency action from going forward, nor does it necessarily compel a conclusion that a proposed action is environmentally unsatisfactory. Rather, the identification of such an effect should heighten agency attention to alternatives (including alternative sites), mitigation strategies, monitoring needs, and preferences expressed by the affected community or population (CEQ 1997).

Federal agencies are required to give affected minority, low-income, and tribal communities opportunities to provide input into the environmental review process, including the identification of potential effects and mitigation measures. The BLM has assured meaningful community representation in the process by:

1) Holding public scoping meetings in the communities of Anchorage, Anaktuvuk Pass, Atqasuk, Fairbanks, Nuiqsut, Point Lay, Utqiaġvik, and Wainwright

2) Coordinating directly with federally recognized tribal governments in compliance with Executive Order 13175 and the BLM's Tribal Consultation policy, which resulted in three consultations with the Native Village of Nuiqsut and two consultations with the Iñupiat Community of the Arctic Slope

3) Conducting consultations with Nuiqsut's ANCSA Native village corporation, Kuukpik, and the regional Native corporation, the ASRC.

In addition, the BLM engaged with communities and tribes through the Western Arctic Herd Working Group and NPR-A Subsistence Advisory Panel.

Following Council on Environmental Quality (CEQ 1997) guidance on evaluating environmental justice under NEPA, the analysis recognizes that the question of whether agency action raises environmental justice issues is highly sensitive to the history or circumstances of a particular community or population. The historical context in which environmental justice issues are considered is presented in the cultural resources and sociocultural systems analyses (**Section 3.4.2** and **Section 3.4.4**). The BLM recognizes the interrelated cultural, social, occupational, historical, or economic factors that are likely to amplify the natural and physical environmental effects of post-lease oil and gas development activities.

Alternative A

Under Alternative A, disproportionately high and adverse effects on minority, low-income, and tribal populations could occur primarily through decreases in the abundance or availability of subsistence resources occurring in the planning area. As discussed in other resource impact analyses in this IAP/EIS, subsistence impacts, in turn, have a sociocultural, economic, and public health dimension. The potential impacts on subsistence uses and resources, sociocultural systems, the economy, and public health under Alternative A are described in detail in **Sections 3.4.3**, **3.4.4**, **3.4.11**, and **3.4.12**, respectively.

According to the BLM (2012a), the subsistence-related adverse impacts of oil and gas development activities in the planning area, including adverse sociocultural, economic, and public health impacts, would decrease in magnitude, extent, and duration under the current IAP due in part to the prohibition of leasing in critically important subsistence and cultural areas. The EIS, however, stated that subsistence-related adverse impacts on minority populations would remain both significant and disproportionately high. Most effects would be long term (i.e., lasting longer than 5 years), with public health effects relating to sociocultural and dietary change, as well as exposure to contaminants, possibly persisting beyond the 50 to 60 years of expected exploration and development activity in the planning area.

As described in **Sections 3.4.3**, **3.4.4**, and **3.4.12**, some non-oil and gas activities that could occur in the planning area under Alternative A, including certain community infrastructure projects, may also have long-term subsistence-related adverse impacts by reducing the abundance or availability of subsistence resources. For example, construction of roads connecting separate communities may facilitate access to subsistence harvesting areas by subsistence users, but over the long term they could divert or disturb subsistence species from their normal movement patterns or activities.

Given the historical and unique nature of the economic, social, and cultural value Alaska Natives place on subsistence resources in the planning area (**Sections 3.4.3** and **3.4.4**) and the importance of these resources to the nutritional health and food security of Alaska Natives (**Section 3.4.12**), the adverse impacts of both post-lease oil and gas development activities and non-oil and gas activities on these resources are expected to continue to be predominately borne by minority populations, and more specifically by Alaska Natives residing in communities that utilize subsistence resources occurring in the planning area. As noted in the description of the affected environment, these communities include those whose households acquire planning area subsistence resources through exchange networks and those whose members directly harvest the resources themselves. Nearly all of the place-based communities are associated with federally recognized tribes. Moreover, impacts on subsistence resources are likely to continue to affect lower-income residents of these communities disproportionately, as they are more dependent on subsistence resources and less capable of adapting to adverse impacts on these resources (BLM 2018a; Kofinas et al. 2016).

Environmental justice impacts are projected to be of the highest intensity in those North Slope communities closest to areas of high oil and gas development potential, such as Nuiqsut and Utqiaġvik (**Section 3.4.3**; see also BLM 2018a); however, if development of the NPR-A results in more substantial changes to the abundance or availability of subsistence resources, disproportionately high and adverse impacts could extend to a broader set of minority, low-income, and tribal communities, including communities outside the planning area.

As noted above, the current IAP includes provisions that mitigate the subsistence-related adverse impacts that underlie many of the environmental justice concerns over oil and gas development activities in the planning area. Scoping comments on the proposed IAP/EIS revisions from groups representing the subsistence interests of Alaska Natives have expressed strong support for the continuation of these provisions. For example, the Western Arctic Herd Working Group requested that the leasing prohibitions and designated special areas in the current IAP be maintained to protect the subsistence use and other uses of the Western Arctic and Teshekpuk Caribou Herds (Cleveland 2019). The BLM also has documented (2019) requests that the BLM retain current protections for all special areas should the IAP be revised.

Under Alternative A, the beneficial local and regional economic impacts of post-lease oil and gas development activities in the planning area are expected to remain concentrated in the North Slope communities and NSB. While North Slope residents would likely continue to occupy only a minor percentage of the direct oil industry jobs, beneficial economic impacts of oil and gas development would accrue to these residents in terms of local government revenues that support jobs filled by residents. Given that a goal of the NSB is to create employment opportunities for Alaska Native residents and that it has been successful in hiring Alaska Natives for borough construction projects and operations (BLM 2012b), it is likely that mainly minority populations would experience these indirect employment impacts of oil and gas development.

Additional economic benefits from NPR-A oil and gas leasing and development expected to continue to accrue to minority populations in North Slope communities under Alternative A include funding to assist local communities to improve public infrastructure and services, profits to ANCSA corporations, and dividends to corporation shareholders. Scoping comments requested that these potential local and regional economic benefits from oil and gas leasing and development be considered should the IAP be revised (BLM 2019). However, while economic benefits related to oil and gas production are a countervailing positive impact, the provision of these benefits does not justify a conclusion that no disproportionately high and adverse effects on minority, low-income, and tribal populations would result under Alternative A; therefore, an environmental justice impact within the meaning of Executive Order 12898 is expected to continue to result from Alternative A.

Impacts Common to All Action Alternatives

As with Alternative A, disproportionately high and adverse effects on minority, low-income, and tribal populations under the action alternatives could occur primarily through decreases in the abundance or availability of subsistence resources occurring in the planning area. Potential impacts on subsistence uses and resources, sociocultural systems, the economy, and public health under each action alternative are discussed in detail in **Sections 3.4.3**, **3.4.4**, **3.4.11,** and **3.4.12**, respectively.

Oil and gas development activities, together with non-oil and gas activities, would continue in the planning area under all the action alternatives. As under Alternative A, the subsistence-related adverse impacts of post-lease oil and gas development activities and non-oil and gas activities, including adverse sociocultural, economic, and public health impacts, would be both significant and disproportionately high on minority, low-income, and tribal populations in communities that utilize planning area subsistence resources. These impacts would differ in relative magnitude and severity across the action alternatives due to differences in the total number of acres available for leasing and new infrastructure. Regardless of the action alternative implemented, as oil and gas development activities occur over a larger area of the planning area, the environmental justice impacts are expected to be long term in communities that utilize subsistence resources occurring in the planning area. Similar to Alternative A, environmental justice impacts are anticipated to be of the highest intensity in those North Slope communities closest to areas with the greatest hydrocarbon potential, such as Nuiqsut and Utqiaġvik; however, if development of the NPR-A results in more substantial changes to the abundance or availability of subsistence resources, disproportionately high and adverse impacts could extend to a broader set of minority, low-income, and tribal communities, including communities outside the planning area. Under all the action alternatives, members of minority, low-income, or tribal populations, as residents of the NSB or shareholders in ANCSA corporations, are expected to experience beneficial economic impacts as a result of post-lease oil and gas development activities. These include increased employment opportunities, shareholder dividends, and local government construction projects and operations, including upgrades to water and sewer systems and improvements in delivery of education, safety, and health care services. However, while economic benefits related to oil and gas production are a countervailing positive impact, the provision of these benefits does not justify a conclusion for any action alternative that no disproportionately high and adverse effects would result. Consequently, an environmental justice impact within the meaning of Executive Order 12898 is expected to result from all the action alternatives.

For all the action alternatives, the effects of climate change described under the *Affected Environment*, above, could influence the rate or degree of the potential disproportionately high and adverse direct and indirect impacts on minority, low-income, or tribal communities. As discussed above, these communities are particularly vulnerable to the effects of climate change because they have fewer financial resources to cope with these effects and because of their economic, nutritional, and cultural dependence on subsistence food resources.

Alternative B

Under Alternative B, the possibility of subsistence-related adverse impacts, including adverse sociocultural, economic, and public health impacts, would be lower compared with Alternative A because Alternative B would decrease the total number of acres available for leasing and new infrastructure. By lowering the potential for subsistence-related adverse impacts, Alternative B is in accordance with a request by the

Western Arctic Herd Working Group that if the BLM chooses to revise the IAP, it selects an alternative that protects comparable or greater amounts of critical habitat for the Western Arctic and Teshekpuk Caribou Herds than what are protected under the current plan (Cleveland 2019). To the extent that subsistence-related adverse impacts, including adverse sociocultural, economic, and public health effects, are reduced under Alternative B, disproportionately high and adverse effects on minority, low-income, and tribal populations in communities that utilize subsistence resources occurring in the planning area would decrease as compared with Alternative A; however, an environmental justice impact within the meaning of Executive Order 12898 is expected to continue to result from Alternative B.

Alternative B could result in a lower revenue stream for North Slope communities, the NSB, and ANCSA corporations and fewer local jobs and business opportunities, which would represent a negative local and regional economic impact. These potential adverse economic impacts would disproportionally affect North Slope community residents, most of whom are Alaska Natives.

Alternatives C and D

Under Alternatives C and D, the possibility of subsistence-related adverse impacts, including adverse sociocultural, economic, and public health impacts, would be higher compared with Alternative A because both alternatives would increase the total number of acres available for leasing and new infrastructure.

To the extent that subsistence-related adverse impacts are higher under Alternatives C and D than under Alternative A, as NPR-A oil and gas development occurs, minority, low-income, and tribal populations in communities that utilize subsistence resources occurring in the planning area would experience a greater level of disproportionately high and adverse subsistence-related effects, including adverse sociocultural, economic, and public health effects. Given that under Alternative D the number of acres available for oil and gas leasing would be the highest of any alternative, the BLM would expect the greatest level of disproportionately high and adverse subsistence-related effects under this alternative.

Revenues to the North Slope communities and NSB from oil and gas development activity in the planning area would increase if many leases were sold under Alternatives C and D. This could represent a beneficial economic impact. However, while economic benefits related to oil and gas production are a countervailing positive impact, the provision of these benefits does not justify a conclusion for any alternative that no disproportionately high and adverse effects would result.

Cumulative Impacts

Study Area and Time Frame

The boundaries of the environmental justice analysis study area for the cumulative impacts analysis are the same as those used for the project-specific analysis. The study area communities identified as areas of potential environmental justice concern are listed in **Appendix V**, **Table V-1**. The general temporal scope for the cumulative effects analysis is from the nineteenth century through 70 years after the ROD signing.

Past and Present Effects

Section 4.8.7.15 of BLM (2012c) provided a detailed description of past and present environmental justice impacts on North Slope communities. In addition, Section 4.8.7.15 summarized these effects as follows:

> Euro-American presence, commercial whaling, and non-oil and gas development and oil and gas exploration and development have had cumulative impacts to Iñupiaq culture and to fish and wildlife used for subsistence. Euro-American presence has impacted the Iñupiat through disease and other ills. Commercial whaling nearly decimated whale stocks in the Chukchi and Beaufort seas and

> the over-harvest of walrus led to hunger and starvation among coastal populations; bowhead whale populations, though recovering, remain nearly 80 percent below levels in the 1800s (Bockstoce 1986). Non-oil and gas development associated with military, residential, and commercial development have directly impacted several thousand acres of fish and wildlife habitat and have also indirectly affected habitat and animal behavior effects that have accumulated and persist today.
>
> Sustained contact with Euro-Americans and oil exploration and development conducted by the federal government and industry have directly impacted the habitat use and behavior of subsistence species and resulted in additive impacts on subsistence resources, harvest patterns, and users. In addition, development associated with villages on the North Slope has adversely affected subsistence resources. These activities cumulatively resulted in the loss of approximately 2,500 acres of habitat for subsistence species. These effects have disrupted subsistence livelihoods and account for some of the social problems seen in Iñupiaq villages today. The economic benefits that NSB communities have accrued due to oil revenues have greatly helped to ameliorate social problems, although dependence on an undiversified economy based on the extraction of natural resources creates other anxieties. Climate change impacts to date have caused social anxiety and climate change is increasingly understood as an environmental justice issue.

Future Effects

A detailed description of reasonably foreseeable environmental justice impacts on North Slope communities is provided in Section 4.8.7.15 of BLM (2012c). Section 4.6.8.11 of BLM (2018b) summarized these effects as follows:

> Non-oil and gas activities on the North Slope, including archaeological and paleontological digs, camps and aircraft traffic associated with scientific studies, recreational use, and overland moves by transport vehicles, would continue to disturb Iñupiaq subsistence resources and cause users to avoid hunting in such areas while these activities are underway. Contaminated sites that persist can have long-term effects that constitute environmental justice issues. The BLM anticipates that several existing military sites will undergo remediation efforts in the next decade. Cleanup projects could potentially have short-term effects (a "plume" created by clean-up activities) that could include a temporary increased potential for contamination of subsistence species, particularly fish, in the area around the cleanup site.
>
> Military sites, villages, airstrips, and other non-oil and gas infrastructure are likely to persist into the indefinite future. The amount of area that would be disturbed by new development on the North Slope in villages and other public facilities is projected to double to approximately 3,600 acres by 2050 and then level off for the remainder of the 21st century. However, a housing shortage and out-migration from North Slope villages is a concern in the NSB. The effects of climate change are expected to become more significant in the future and it is likely that Iñupiaq communities will bear a disproportionate burden of those effects….
>
> Disturbance of caribou and other subsistence resources caused by additional [oil and gas] development would accumulate with impacts from existing disturbances. Oil and gas activities near the project area have already deterred subsistence hunters from using traditional hunting, fishing, and camping sites. Continued expansion of activity and infrastructure near the project area will increase the area considered less desirable by resource users, could deflect or divert important subsistence resources from their normal routes, and require users to travel further to harvest

subsistence foods at a greater cost in terms of time, fuel, wear and tear on equipment and people, and lost wages.

Impacts to Nuiqsut's subsistence resources and use areas from future oil and gas activities are expected to be additive with respect to impacts from other past, present, and future non-oil and gas activities and past and present oil and gas activities. The number and proximity of current and reasonably foreseeable future oil exploration and development projects within 40 miles of Nuiqsut. is substantially greater now than it has been for previous cumulative effects analyses. These projects in the Nuiqsut region will increase the total level of disturbance and the amount of subsistence use areas impacted by oil and gas development.

Contribution of the Alternatives to Cumulative Effects

The BLM expects the disproportionately high and adverse effects on minority, low-income, and tribal populations from future oil and gas exploration and development in the planning area to be additive or synergistic with respect to impacts from other past, present, and future activities unrelated to oil and gas development as well as past, present, and future oil and gas activities. All these activities create significant concerns for Alaska Natives because they are perceived as factors beyond their control and that are threatening their way of life.

The disproportionately high and adverse cumulative impacts on minority, low-income, and tribal populations are expected to be long term and of high intensity (BLM 2018a). The substantially greater economic stability brought by oil development on the North Slope has helped mitigate much of the stress commonly associated with poverty and other issues in recently settled indigenous populations; however, it does not remove issues of environmental justice (BLM 2012a).

The extent of expected cumulative effects on environmental justice issues would vary depending on the alternative selected. Under Alternative B, the adverse subsistence-related effects, including adverse sociocultural, economic, and public health impacts, would be lower than under Alternative A due to the decrease in the number of acres available for leasing and new infrastructure. Consequently, the contribution of Alternative B toward the overall cumulative environmental justice impacts within the geographic and temporal scope of the analysis would be less than that described under Alternative A. Conversely, because the adverse subsistence-related effects under Alternatives C and D would be higher than under Alternative A due to the increase in the number of acres available for leasing and new infrastructure, the contribution of the two alternatives toward the overall cumulative environmental justice impacts would be greater than that described under Alternative A.

Under all the action alternatives, the effects of climate change described under *Affected Environment* above, could influence the rate or degree of the potential cumulative impacts on minority, low-income, or tribal communities. As discussed above, these communities are particularly vulnerable to the effects of climate change. This is because they have fewer financial resources to cope with these effects and because of their economic, nutritional, and cultural dependence on subsistence food resources.

3.4.6 Recreation

Affected Environment

The vast Arctic region of the NPR-A offers unique recreational opportunities. The recreation experience is primarily primitive, and the entire area is considered an unmodified natural environment. Individual users rarely, if ever, encounter other recreationists; however, the remote nature of the region makes it difficult to access, and recreational use within the NPR-A accounts for only approximately 1 percent of total Alaskan outdoor recreational opportunities. Recreational opportunities and settings are described in the 2012 NPR-A Final IAP/EIS (BLM 2012, Section 3.4.6). A summary is provided below.

Primary recreational activities in the planning area include backpacking/hiking, boating, sight-seeing, hunting, fishing, tourism, and off-highway vehicles. Data are primarily available for guided trips requiring authorization to access public lands for commercial recreation. While non-guided activities occur within the planning area, no data are available for these activities. No BLM-maintained or authorized recreational infrastructure exists within the NPR-A planning area.

Guided expeditions for backpacking, sight-seeing, and hunting primarily occur along the southern NPR-A to access the Utukok River. Similar recreation also occurs at or near Teshekpuk Lake and Umiat. Commercial operators conduct backpacking, hiking, sight-seeing, and hunting excursions throughout the southern portions of the NPR-A. Operators primarily guide expeditions into the Utukok River Special Area; however, some lead expeditions into Umiat via private plane.

There is recreational hunting, independent of subsistence hunting (see **Section 3.4.3**), for bears, caribou, and sheep in the planning area. The NPR-A lies within the State Game Management Area 26A, and while hunters can apply for individual permits, those permits are not specific to Alaskan game management areas. Guided hunting requires a special recreation permit. There is a commercial operator that flies clients into Umiat; however, most special recreation permit holders fly clients to Ivotuk for access to hunting across the southeast portion of the NPR-A.

Recreational fishing, independent of subsistence fishing (see **Section 3.4.3**), primarily occurs opportunistically in the planning area during non-winter conditions. Individual anglers obtain licenses through the Alaska Department of Fish and Game, and licensure is not specific to recreational areas. Commercial sport fishing activities are required to obtain special recreation permits from the BLM in advance of the activity.

Other recreational activities, such as sight-seeing, and tourism also occur in the planning area, but to a lesser degree. Sight-seeing provides visitors with immeasurable value given the unique wildlife and landscape characteristics of the NPR-A. Tourism is a growing industry throughout the state of Alaska, but the lack of access opportunities within the NPR-A planning area suggests most tourism-related activities would be guided activities.

Climate Change

Natural events have the potential to disrupt the recreational setting. The planning area is one of the fastest warming regions in the United States, with average annual temperatures having increased roughly 3 degrees Fahrenheit over the past 60 years (Markon et al. 2018). Climate extremes may affect recreational quality and opportunities through the increased potential of prolonged drought, extended periods with no snow cover, and high-intensity precipitation events (SNAP 2018).

Direct and Indirect Impacts

Potential impacts on recreation would result from management that enhances or diminishes the quality of the recreational setting; limits access or physically displaces visitors or subsistence users because of new surface disturbance or development; increases or decreases conflicts between recreational uses, such as in high use areas; increases or decreases the ability of commercial operators to carry out specially permitted activities; or enhances or diminishes subsistence opportunities.

The effects of climate change described under *Affected Environment*, above, could influence the rate or degree of the potential direct and indirect impacts. The effects of climate change described under the *Affected Environment*, above, are part of the baseline conditions for recreation in the project area. See **Section 3.2.1** for a detailed discussion of the alternatives' contributions to global climate change.

Alternative A

Under Alternative A, the planning area would continue to be managed as described in the 2012 NPR-A Final IAP/EIS (BLM 2012). Approximately 11,763,000 acres would be available for lease sales, 67.3 percent of which (7,920,000 acres) would be available for surface use. Alternative A would make 8,312,000 acres, approximately 36.5 percent of the planning area, unavailable for new infrastructure development along Teshekpuk Lake and the southwestern NPR-A. Under Alternative A, the Teshekpuk Lake Special Area would be closed to fluid mineral leasing, and sight-seeing recreational opportunities would continue as described under the *Affected Environment*. No pipeline ROWs would be approved under this alternative.

Alternative A would subject 2,492,000 acres (21.2 percent of lands available for leasing) to NSO stipulations and require setbacks along popular river corridors in the planning area, which are described in **Chapter 2**, **Table 2-1**. Setbacks help better maintain recreational opportunities and avoid the displacement of visitors in those popular recreation corridors. The intensity of impacts would depend on structure height, topography, and vegetation, which influence a recreationist's line of sight from the river corridor.

Management decisions under Alternative A would mitigate the potential for recreational conflict and help maintain the quality of recreation as described in the *Affected Environment*.

Impacts Common to All Action Alternatives

The magnitude, spatial extent, and duration of potential impacts on recreation would vary based on the season, type of recreation, location in the program area, and phase of the hypothetical baseline scenario. In general, the potential for impacts on recreation would be greatest during the summer and fall, when weather and daylight conditions allow for the greatest number and type of recreational uses. Similarly, the potential for impacts would be greatest along the river corridors, the Teshekpuk Lake Special Area, and the southern portion of the NPR-A along the Utukok River Special Area and Umiat, where commercial recreation operations occur. Because visitors to the program area generally expect a physical setting consisting of little to no human disturbance and a social setting with little to no interaction with other visitors or human activity, small changes can have disproportionately large impacts on user experiences.

The five phases of development would vary the magnitude, spatial extent, and duration of impacts. Under the leasing phase, no impacts would occur. This is because the lease itself does not authorize any on-the-ground oil and gas activities. During the exploration phase, recreational opportunities would decline from dispersed exploration activities and the associated impacts from generated noise, dust, and visual disruption. Recreational access may also decline from increased congestion along existing gravel and ice roadway networks, particularly along the Community Winter Access Trail and Spine Road, as exploration activities are prohibited from developing new roadways.

During the development phase, noise and visual impacts would disrupt the quality of recreation in the planning area. Gravel pits, a seawater treatment plant, and central processing facilities may be developed to support mineral development; however, under the development phase, NSO lease stipulations attach and vary by alternative. Construction activities would likely intensify over time and lead to a steady increase in surface disturbance, which may increase the potential for visitor displacement and restrictions on access for visitors. During the production phase, the dispersion of impacts would concentrate to prospected and developed drill sites; however, permanent disruptions to the visual landscape would remain through the abandonment and reclamation phase. During the abandonment and reclamation phase, impacts would result from noise and visual disruptions associated with retiring inefficient equipment and drill sites.

The program area offers recreationists primitive and guided recreational experiences, such as backpacking, hiking, sight-seeing, and hunting, which are unique on a global scale and depend largely on the physical setting. Visual quality contributes to the physical setting and directly influences recreationists' desire and satisfaction with recreation in the program area. Undisturbed landscapes contribute to higher-quality recreational opportunities; disturbed landscapes may affect the desirability of recreation in the program area and displace recreation to areas outside the NPR-A. Where aboveground development is allowed, lease stipulations that minimize the visual contrast of new development, such as by requiring design elements that complement the predominant natural features of the characteristic landscape, would reduce the intensity of visual impacts and the associated change to the recreational setting. See **Section 3.4.9**, Visual Resources, for a description of visual impacts on the program area.

Visual disruption, noise from post-lease mineral development, and physical barriers from oil and gas-related infrastructure have the potential to alter the recreational setting, diminish visitor experiences, or physically displace recreational opportunities. The addition of artificial lighting at facilities in the future and from vehicles would diminish the quality of night sky conditions, especially in the winter and spring, when daylight hours are shortest. The flat topographic characteristics of the NPR-A would result in new facilities being visible from far distances. Protective measures, described in **Section 3.4.9**, Visual Resources, would minimize impacts on nighttime recreation.

Noise will likely intensify during the exploration and development phases, as impacts would be dispersed through leased areas. During the production phase, noise would be site specific to facility operations; however, noise impacts would likely last through the longevity of the production phase. More frequent access to the NPR-A, via vehicle or aircraft, could also increase the occurrence of noise impacts.

New infrastructure can physically displace or preclude access to recreational opportunities. Displacement could begin during the exploration phase, as exploratory activities could reduce the desirability of recreational locations. These impacts would intensify through the development and production phases, where physical displacement and reduced recreational quality would last through the longevity of the infrastructure lifespan.

The magnitude of potential impacts from visual disruption, noise, dust, or physical barriers would depend on the location of development and recreational activity affected. The potential for impacts would be greatest during the summer and fall when visitation is highest and near river corridors and other areas where visitors concentrate; however, permanent infrastructure would displace all types of visitors year-round and over the long term.

River buffers for each alternative, presented in **Chapter 2**, **Table 2-3**, would vary in their ability to provide opportunities for vegetation or topography to provide consistent screening of new facilities or vehicle traffic from users in river corridors. Drill pads, roads, and pipelines near these river corridors would also physically displace visitors from areas outside the setbacks. Concentrating recreational uses in narrow river corridors would increase the density of activity in those corridors, which would increase the number of interactions among visitors. This would directly affect the social setting and could increase the potential for conflicts among different types of recreational users. Buffers greater than 2 miles would better maintain recreational opportunities and avoid the displacement of visitors in these areas by providing a greater opportunity for vegetation or topography to provide consistent screening of new facilities or vehicle traffic from view of users in the river corridors. The intensity of the impact would depend on structure height, topography, and vegetation that influence a user's line of sight from the river corridor.

There are currently five special recreation permit holders operating in the entire NPR-A; however, there are currently no special recreation permit holders operating in the exploration or development areas. Recreationists in the program area rely heavily on commercial operators for access to desired recreational opportunities and experiences. Changes in resource conditions, including physical resources, such as visual quality, and biological conditions, such as wildlife, would directly influence the quality of recreational experiences obtained through commercial operators. Commercial operators flying into Umiat would be more likely to come into contact with post-lease activities, as the region is identified as a high hydrocarbon potential zone. Another potential indirect impact of reduced access to the program area would be recreational displacement to areas outside the program area. Mineral development activities would be unlikely to affect commercial operators accessing the Utukok River Special Area given its low hydrocarbon potential.

Alternative B

Alternative B would reduce the lands available for leasing to 11,420,000 acres, 66.8 percent of which (7,629,000 acres) would be available for surface use without timing limitations. Potential direct and indirect impacts on recreation would primarily occur in the high and medium hydrocarbon potential zones identified in the RFD scenario (see **Appendix B**, **Section B.8**), and the types of impacts described under *Impacts Common to All Action Alternatives* would occur from post-lease activities throughout the five phases of development. Increasing the lands unavailable for new infrastructure development to 10,537,000 acres, approximately 46.3 percent of the planning area, would reduce the potential for recreational conflict with oil and gas activities and likely enhance the recreational quality of the planning area when compared with Alternative A.

Under Alternative B, two pipeline corridor ROWs would be approved to support oil and gas production in the high hydrocarbon potential zone, covering approximately 189,000 acres. While the location of the pipeline ROW would be subject to a new analysis, leasing stipulations (K-6 and K-8) and ROPs (E-24), and development would likely impede the visual quality of the areas near Teshekpuk Lake, where sight-seeing is common. Construction activities would intensify throughout the development phase, and visual impacts would be sustained through the production phase. Development of pipelines near the Teshekpuk Lake Special Area would likely reduce opportunities for sight-seeing recreation compared with Alternative A.

Increasing the land subject to NSO leasing stipulations to 3,791,000 acres (33.2 percent of lands available for leasing), primarily along rivers and deep-water lakes, would reduce the potential for conflict with recreational users and improve recreational quality compared with Alternative A. Alternative B would increase the required setbacks along popular river corridors, described in **Chapter 2**, **Table 2-3**, and would better maintain recreational opportunities and avoid the displacement of visitors compared with Alternative A.

Alternative C

Alternative C would increase lands available for lease sales to 17,053,000 acres, 66.9 percent of which (11,418,000 acres) would be available for surface use subject to standard terms and conditions, compared with Alternative A. Potential impacts on leased land would be the same as those described under *Impacts Common to All Action Alternatives* and would primarily occur within the high and medium hydrocarbon potential zones described in **Appendix B, Section B.8** through the five phases of development. Reducing the lands unavailable for new infrastructure development to 5,133,000 acres, approximately 22.6 percent of the planning area, would likely increase the potential for recreational conflict with oil and gas activities and reduce the recreational quality of the planning area when compared with Alternative A.

Under Alternative C, one pipeline corridor ROW would be approved to support oil and gas production in the high hydrocarbon potential zone on approximately 73,000 acres, as more land would be available for new infrastructure development. Development of pipeline infrastructure would be subject to the same stipulations described under Alternative B. Compared with Alternative A, impacts on sight-seeing recreation within the Teshekpuk Lake Special Area would increase from pipeline developed and the increased acreage available for new infrastructure development.

Alternative C would designate 5,013,000 acres (29.4 percent of lands available for leasing) with NSO leasing stipulations, increasing the percentage of designated land compared with Alternative A. Alternative C would decrease the required setbacks and increase the potential for visual impacts; it would reduce recreational quality and increase visitor displacement along popular recreational corridors when compared with Alternative A.

Alternative D

Alternative D would increase the acres available for lease sales to 18,324,000 acres, 65.8 percent of which (12,070,000 acres) would be available for surface use subject to standard terms and conditions, compared with Alternative A. Potential impacts would be the same as those described under *Impacts Common to All Action Alternatives*. Among all action alternatives, Alternative D would provide the least amount of land unavailable for new infrastructure development, with approximately 4,531,000 acres (19.9 percent of the planning area). Impacts from infrastructure development related to oil and gas activities on visual quality, noise, night sky, and recreational quality would be highest under this alternative. Intensification of impacts would begin during the exploration phase from roadway development to identify prospect locations and increase through the production phase from construction of well facilities and the associated infrastructure.

No pipeline ROWs would be approved under Alternative D as more land would be available for new infrastructure development. By opening all of the Teshekpuk Lake Special Area for leasing, impacts on sight-seeing recreation would be highest under this alternative. Impacts would begin during the exploration phase and intensify through the production phase with the construction of oil and gas facilities. Impacts would reduce sight-seeing recreational opportunities, reduce the recreational quality, and likely displace sight-seeing recreation to areas outside the planning area.

Alternative D would designate 4,653,000 acres (25.4 percent of lands available for leasing) with NSO stipulations. Setbacks along river corridors would be the same as those described under Alternative C; however, with the increase in lands available for new infrastructure development, the effectiveness of river setbacks may be insufficient to mitigate against visual impacts on recreational quality.

Cumulative Impacts

The geographic area of potential cumulative impacts on recreation is the planning area. Potential cumulative impacts on recreation would be the result of actions or circumstances, both in or outside the ability of the BLM to manage, that would enhance or diminish the quality of the recreational setting, limit access or displace visitors or subsistence users, increase or decrease conflicts between recreationists, increase or decrease the ability of commercial operators to carry out specially permitted activities, or enhance or diminish subsistence opportunities. Past, present, and RFFAs described in **Appendix F, Section F.3.2** that would cumulatively affect recreation include increasing recreational use in the program area, and energy and infrastructure development.

Under all action alternatives, oil and gas development from projects such as the Alaska LNG and the ASAP would increase the presence of well pads, pipelines, roads, and other infrastructure, which would potentially displace recreation in the program area. Increased use along the Dalton Highway to access oil and gas projects may adversely affect the ability of recreationists to access the program area. Combined with increased visitation and other RFFAs, new infrastructure development would diminish the quality of the recreational setting and associated recreational experience. These potential impacts would last until the infrastructure is removed and the areas reclaimed.

New roads associated with private industry development will be available to private industry access and subsistence use only. The intensity of impacts on visitor experiences and the recreational setting would be greatest in areas where infrastructure is visible and operations are audible. Visitors displaced from certain areas because of oil and gas activity could choose alternate locations in the program area to recreate, which could lead to more frequent conflicts among recreationists in those areas.

Impacts from seismic exploration have the potential to occur across the entire program area, even if an area is unavailable for lease sale. Seismic exploration may adversely affect recreation in the program area by disrupting the visual landscape with camp trailers and seismic equipment. However, there are currently no winter special recreation permit holders, so seismic exploration conducted in winter would not affect recreational quality.

The effects of climate change described under the *Affected Environment*, above, could influence the rate or degree of the potential cumulative impacts (SNAP 2018).

3.4.7 Wild and Scenic Rivers

Affected Environment

Wild and Scenic Rivers are rivers or segments of rivers designated by Congress under the authority of the Wild and Scenic Rivers Act of 1968 (PL 90-542, as amended; 16 USC 1271–1287). The Wild and Scenic Rivers Act mandates protections for rivers that are designated rivers of the National Wild and Scenic Rivers System. Federal managers of rivers that were recommended pursuant to a Congressionally authorized Wild and Scenic River study are obligated to use existing management authorities to protect the characteristics of rivers for the conditions under which they were found eligible and suitable. A river's preliminary classification (wild, scenic, or recreational, based on the level of development), free-flowing condition, water quality, and outstandingly remarkable values must be maintained. Wild and Scenic Rivers are identified on a segment-specific basis and may include scenic, recreational, geologic, fish and wildlife, historic, cultural, or other similar values. The discussion below tiers to and incorporates by reference relevant information from the 2012 NPR-A Final IAP/EIS (BLM 2012, Section 3.4.7).

To fulfill the requirement of the Wild and Scenic Rivers Act,[12] the BLM studied the rivers in the NPR-A during the 2012 NPR-A Final IAP/EIS (BLM 2012, Section 3.4.7). There has been no change in circumstances that would warrant an additional review of eligibility, and there has been no change in suitability factors previously identified. Because all eligible rivers have been studied for suitability, criteria

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[10] https://www.rivers.gov/documents/wsr-act.pdf

from BLM Manual 6400[13] have been satisfied. For these reasons, the BLM is not revisiting the existing evaluations of and determinations for eligible and suitable rivers in this effort.

The 2012 NPR-A Final IAP/EIS (BLM 2012, Section 3.4.7) considered 12 rivers or river segments to be eligible for Wild and Scenic River designation (see **Table 3-37**); however, the ROD (BLM 2013, Section 1) did not determine them to be suitable for designation and did not recommend to Congress that they be added into the National Wild and Scenic Rivers System; instead, it recommended protections of their Wild and Scenic River values through other means. The eligible rivers and river segments are entirely within the BLM's management. Under the 2013 NPR-A IAP ROD (BLM 2013, Section 1), the BLM manages all 12 rivers or river segments to protect their free-flowing condition, water quality, and outstandingly remarkable values as an alternative method of protection that preserves Congress's option to pursue Wild and Scenic River designation if warranted in the future.

Table 3-37
Rivers Eligible for Wild and Scenic River Status in the NPR-A Planning Area

River Name	Extents	Miles in the Planning Area	Outstandingly Remarkable Values
Awuna River	Headwaters to Colville	203	wildlife, scenic, cultural, geologic, subsistence, and recreational
Carbon Creek	Headwaters to Utukok	54	recreational, wildlife, scenic, cultural, and subsistence
Colville River	From headwaters (Storm Creek) downstream in all portions in which the river and both banks are in the NPR-A	174	wildlife, scenic, cultural, geologic, and subsistence
Driftwood Creek	Headwaters to Utukok	36	wildlife, scenic, cultural, geologic, and subsistence
Etivluk River	From confluence with Nigu to Colville	81	recreational, wildlife, scenic, and cultural
Ipnavik River	Headwaters to Colville	83	wildlife and scenic
Kiligwa River	Headwaters to Colville	51	wildlife, scenic, cultural, geologic, and subsistence
Kokolik River	Southern NPR-A boundary to northern boundary	73	recreational, wildlife, geologic, cultural, and subsistence
Kuna River	Headwaters to Colville	63	wildlife and scenic
Nigu River	From NPR-A southern boundary to confluence with Etivluk River	40	recreational, wildlife, scenic, and cultural
Nuka River	Headwaters to Colville	55	wildlife and scenic
Utukok River	Headwaters at confluence of Tupik and Kogruk creeks to NPR-A southern boundary approximately 198 miles	222	recreational, wildlife, scenic, subsistence, and cultural

Source: BLM 2012, Section 3.4.7

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[11] https://www.blm.gov/sites/blm.gov/files/uploads/mediacenter_blmpolicymanual6400.pdf

Direct and Indirect Impacts

Table 3-38 lists the miles of eligible rivers that would be available for leasing under each alternative.

Table 3-38
Affected Rivers Eligible for Wild and Scenic River Status in the NPR-A Planning Area

River Name	Acres of Wild and Scenic River Eligible Corridors in the Planning Area Available for Fluid Mineral Leasing			
	Alternative A	Alternative B	Alternative C	Alternative D
Awuna River	123,000	198,000	181,000	181,000
Carbon Creek	28,000	33,000	33,000	31,000
Colville River	184,000	1,705,000	607,000	590,000
Driftwood Creek	22,000	24,000	24,000	24,000
Etivluk River	26,000	49,000	44,000	44,000
Ipnavik River	39,000	61,000	52,000	52,000
Kiligwa River	27,000	42,000	35,000	35,000
Kokolik River	74,000	93,000	93,000	93,000
Kuna River	24,000	44,000	38,000	38,000
Nigu River	24,000	25,000	25,000	25,000
Nuka River	33,000	44,000	37,000	37,000
Utukok River	242,000	321,000	321,000	298,000

Source: BLM GIS 2019

Evidence of climate change is apparent in Alaska. Temperature increases and precipitation changes have changed regional hydrology. Continuation of these trends may lead to changes in the hydrologic cycle (SNAP and TWS 2009, p. 1). These changes could affect soils and the vegetation along the eligible and suitable streams, most noticeably by taller shrub intrusion and thawing permafrost. This would affect the scenic quality of areas viewable from the stream by limiting vistas. It is possible that melting permafrost could increase sedimentation and turbidity in these streams, reducing water quality.

The effects of climate change described above are part of the baseline conditions for wild and scenic rivers in the project area. See **Section 3.2.1** for a detailed discussion of the alternatives' contributions to global climate change.

Alternative A

Under Alternative A, none of the 12 eligible rivers listed in **Table 3-38** would be found suitable for recommendation into the National Wild and Scenic Rivers System. Oil and gas leasing would not be prohibited from any of the eligible river areas; however, 846,000 acres of river corridor would be managed subject to BMPs and NSO stipulations, which would provide protections from potential impacts on the free-flowing condition, water quality, and outstanding remarkable values of the eligible rivers.

No oil and gas development is expected near eligible river areas because all of the 12 eligible rivers are in areas of low potential for exploration and development. If leasing were to occur in the eligible river areas, there would be setback distances, stipulations, BMPs, and ROPs, which would provide protections from potential impacts on the free-flowing condition, water quality, and outstandingly remarkable values of the eligible rivers. BMP K-3 would provide protections for eligible rivers during the exploratory drilling phase by prohibiting this activity in rivers and streams, as determined by the active floodplain, and fish-bearing lakes. BMP B-1 would provide protections to the free-flowing condition of eligible rivers during the production phase by prohibiting the withdrawal of unfrozen water from rivers and streams during winter. BMP C-2 would provide protections to the free-flowing condition and water quality of eligible rivers by limiting ground operations during the spring snowmelt. BMP C-3 would provide protections to the free-flowing condition and water quality of eligible rivers by using a low-angle approach for waterway crossings. BMP C-4 would provide protections to the free-flowing condition of eligible rivers by prohibiting travel in streambeds and using grounded ice whenever possible for river crossing. BMP E-8 would provide protections to eligible rivers by requiring gravel mine site design and reclamation to consider the construction of gravel mine sites within active floodplains.

Impacts Common to All Action Alternatives

Under all action alternatives, the BLM would maintain water quality and ensure that authorized uses comply with state water quality standards. Management actions that prohibit surface-disturbing activities, including NSOs, and timing limitations near the eligible rivers would provide varying protections for outstanding remarkable values. This also would ensure that the free-flowing condition of the rivers remains intact. General impacts resulting from oil and gas development in the NPR-A could include potential soil erosion and habitat fragmentation, which could affect cultural, fish, geologic, recreation, scenic, and wildlife outstanding remarkable values. The degree of impacts on Wild and Scenic Rivers would depend on the proximity of development to the Wild and Scenic River.

Non-oil and gas activities, such as transportation and communication rights-of-way, research permits, and special recreation permits, would not cause noticeable impacts on the eligible rivers. The 12 eligible rivers would retain their free-flowing condition and would not experience changes to water quality.

Appendix B, **Section B.9** summarizes hypothetical development scenarios that could occur under each alternative for the leasing, exploration, development, production, and abandonment and reclamation phases of oil and gas activities. A site-specific analysis would occur during the Application for Permit to Drill phase of development. Impacts on recreational uses of the rivers are described under **Section 3.4.6**, Recreation.

Under all action alternatives, all major rivers in the NPR-A would have 0.5- to 7-mile setback distances (see **Table 3-39**). Within these setback areas, permittees could construct essential pipeline and roads that cross the river, but no other permanent infrastructure would be permitted.

Table 3-39
Eligible Wild and Scenic River Setback Distances Under Each Alternative

River Name	Setback Distances			
	Alternative A	Alternative B	Alternative C	Alternative D
Awuna River	0.5-mile setback from the ordinary high watermark	0.5-mile setback from the ordinary high watermark	0.5-mile setback from the ordinary high watermark	0.5-mile setback from the ordinary high watermark
Carbon Creek	0.5-mile setback from the ordinary high watermark	0.5-mile setback from the ordinary high watermark	0.5-mile setback from the ordinary high watermark	0.5-mile setback from the ordinary high watermark

River Name	Setback Distances			
	Alternative A	Alternative B	Alternative C	Alternative D
Colville River	2-mile setback from the highest high watermark on the left (western or northern) bank; above the juncture of Thunder and Storm Creeks the setback would be 0.5 miles	7-mile setback from the highest high watermark on the left (western or northern) bank to the juncture of Thunder and Storm Creeks	3-mile setback from the highest high watermark on the left (western or northern) bank; above the juncture of Thunder and Storm Creeks the setback would be 1 mile	3-mile setback from the highest high watermark on the left (western or northern) bank; above the juncture of Thunder and Storm Creeks the setback would be 1 mile
Driftwood Creek	0.5-mile setback from the ordinary high watermark	0.5-mile setback from the ordinary high watermark	0.5-mile setback from the ordinary high watermark	0.5-mile setback from the ordinary high watermark
Etivluk River	0.5-mile setback from the ordinary high watermark	0.5-mile setback from the ordinary high watermark	0.5-mile setback from the ordinary high watermark	0.5-mile setback from the ordinary high watermark
Ipnavik River	0.5-mile setback from the ordinary high watermark	0.5-mile setback from the ordinary high watermark	0.5-mile setback from the ordinary high watermark	0.5-mile setback from the ordinary high watermark
Kiligwa River	0.5-mile setback from the ordinary high watermark	0.5-mile setback from the ordinary high watermark	0.5-mile setback from the ordinary high watermark	0.5-mile setback from the ordinary high watermark
Kokolik River	1-mile setback from the ordinary high watermark	1-mile setback from the ordinary high watermark	1-mile setback from the ordinary high watermark	1-mile setback from the ordinary high watermark
Kuna River	0.5-mile setback from the ordinary high watermark	0.5-mile setback from the ordinary high watermark	0.5-mile setback from the ordinary high watermark	0.5-mile setback from the ordinary high watermark
Nigu River	0.5-mile setback from the ordinary high water mark from the confluence with the Etivluk River upstream to the southern boundary of the NPR-A	0.5-mile setback from the ordinary high water mark from the confluence with the Etivluk River upstream to the southern boundary of the NPR-A	0.5-mile setback from the ordinary high water mark from the confluence with the Etivluk River upstream to the southern boundary of the NPR-A	0.5-mile setback from the ordinary high water mark from the confluence with the Etivluk River upstream to the southern boundary of the NPR-A
Nuka River	0.5-mile setback from the ordinary high watermark	0.5-mile setback from the ordinary high watermark	0.5-mile setback from the ordinary high watermark	0.5-mile setback from the ordinary high watermark
Utukok River	1-mile setback from the ordinary high watermark	1-mile setback from the ordinary high watermark	1-mile setback from the ordinary high watermark	1-mile setback from the ordinary high watermark

Source: **Chapter 2**

Alternative B

Under Alternative B, all of the 12 eligible rivers listed in **Table 3-39** would be found suitable for recommendation into the National Wild and Scenic Rivers System. There would be 342,000 acres of river corridor along 1,134 miles of rivers that would be suitable and recommended into the National Wild and Scenic River System.

The 12 eligible rivers would be managed as wild river areas. Aircraft overflights over eligible rivers might increase from oil and gas activities elsewhere in the planning area, and if this happens, there would be some impact on recreation and subsistence users. Recreation experiences would be less primitive, and subsistence hunts could be disrupted by such overflights (BLM 2012, Section 4.4.17.2). Under Alternative B, overflights would have fewer effects on eligible rivers compared with Alternative A due to fewer areas being available for oil and gas activities in the planning area.

No oil and gas development would be expected near eligible rivers because all of the 12 eligible rivers are in areas of low potential for oil and gas exploration and development. Similar to Alternative A, if leasing were to occur in the eligible river areas, there would be setback distances, stipulations, BMPs, and ROPs, which would provide protections from potential impacts on the free-flowing condition, water quality, and outstandingly remarkable values of the eligible rivers.

Alternative C

Under Alternative C, none of the 12 eligible rivers listed in **Table 3-39** would be found suitable for recommendation into the National Wild and Scenic Rivers System. Oil and gas leasing would not be prohibited from any of the eligible river areas; however, 1,490,000 acres of river corridor would be managed subject to BMPs and NSO stipulations under Alternative C, which would provide protections from potential impacts on the free-flowing condition, water quality, and outstandingly remarkable values of the eligible rivers.

Aircraft overflights over eligible rivers might increase from oil and gas activities elsewhere in the planning area, and if this happens, there would be some impact on recreation and subsistence users. Recreation experiences would be less primitive, and subsistence hunts could be disrupted by such overflights (BLM 2012, Section 4.4.17.2). Under Alternative C, overflights would affect eligible rivers more than under Alternative A due to more areas being available for oil and gas activities in the planning area.

No oil and gas development would be expected near eligible rivers because all 12 eligible rivers are in areas of low hydrocarbon potential for exploration and development. Similar to Alternative A, if leasing were to occur in the eligible river areas, there would be setback distances, stipulations, BMPs, and ROPs, which would provide protections from potential impacts on the free-flowing condition, water quality, and outstandingly remarkable values of the eligible rivers.

Alternative D

Under Alternative D, none of the 12 eligible rivers listed in **Table 3-39** would be found suitable for recommendation into the National Wild and Scenic River System. Oil and gas leasing would not be prohibited from any of the eligible river areas; however, 1,448,000 acres of river corridor would be managed subject to BMPs and NSO stipulations under Alternative D, which would provide protections from potential impacts on the free-flowing condition, water quality, and outstandingly remarkable values of the eligible rivers.

Aircraft overflights over eligible rivers might increase from oil and gas activities elsewhere in the planning area, and if this happens, there would be some impact on recreation and subsistence users. Recreation experiences would be less primitive, and subsistence hunts could be disrupted by such overflights (BLM

2012, Section 4.4.17.2). Under Alternative D, overflights would affect eligible rivers more than under Alternative A due to more areas being available for oil and gas activities in the planning area.

No oil and gas development would be expected near eligible rivers because all 12 eligible rivers are in areas of low potential for exploration and development. Similar to Alternative A, if leasing were to occur in the eligible river areas, there would be setback distances, stipulations, BMPs, and ROPs, which would provide protections from potential impacts on the free-flowing condition, water quality, and outstandingly remarkable values of the eligible rivers.

Cumulative Impacts

The cumulative impacts analysis period is from the 1970s through full realization of the hypothetical development scenario, which is anticipated to occur approximately 70 years after the ROD for this EIS is signed. The ending date is based on the assumption that oil and gas fields will be discovered and developed in the planning area over approximately the remainder of the first half of this century and that production and abandonment activities could last for approximately 50 more years. The geographic area of potential cumulative impacts includes the areas up to 7 miles on either side of the ordinary high water mark of the 12 eligible rivers in the planning area.

Oil and gas development activities in the NPR-A are expected to continue along current trends. As development and transportation increase in and around the planning area, access and use in or next to rivers would also increase.

All action alternatives would incrementally contribute to potential cumulative effects on eligible Wild and Scenic Rivers from post-leasing oil and gas activities. Alternative B would have the lowest incremental contribution to potential cumulative impacts. This is because all eligible rivers would be managed as suitable, and more areas would be closed to fluid mineral leasing and managed with NSO requirements. Alternative D would have the greatest incremental contribution to potential cumulative impacts because no eligible rivers would be managed as suitable, and Alternative D would have the most acres available for leasing without NSO stipulations. The effects of climate change described under the *Affected Environment*, above, could influence the rate or degree of the potential cumulative impacts.

3.4.8 Wilderness Characteristics

Affected Environment

This section tiers to and incorporates by reference relevant information from the 2012 NPR-A Final IAP/EIS (BLM 2012, Section 3.4.6), which described wilderness characteristics in the planning area. There have been no new data gathered on the wilderness values associated with the planning area since the completion of the 2012 NPR-A Final IAP/EIS (BLM 2012); however, new oil and gas development has occurred at the Alpine Colville Delta-5, and the GMT1 and GMT2 drill sites near Nuiqsut.

The 1964 Wilderness Act[14] established a national system of lands to preserve a representative sample of ecosystems in a natural and wild condition for the benefit of future generations. The Wilderness Act describes four primary qualities of wilderness:

- It generally appears to have been affected primarily by the forces of nature, with the imprint of man's work substantially unnoticeable.

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[14] https://winapps.umt.edu/winapps/media2/wilderness/NWPS/documents/publiclaws/PDF/16_USC_1131-1136.pdf

- It has outstanding opportunities for solitude or a primitive and unconfined type of recreation.
- It has at least 5,000 acres or is of sufficient size as to make practicable its preservation and use in an unimpaired condition.
- It may also contain ecological, geological, or other features of scientific, educational, scenic, or historic value.

The 1981 Appropriations Act exempted the NPR-A from Federal Land Policy and Management Act of 1976 Section 603 (43 USC 1782), which requires the completion of wilderness reviews and describes the procedures for managing any lands recommended to Congress for wilderness designation, pending congressional action. Section 1320 of the Alaska National Interest Lands Conservation Act (43 USC 1784), however, grants the Secretary of the Interior discretionary authority to "identify areas in Alaska which he determines are suitable as wilderness" and states that the Secretary "may, from time to time, make recommendations to the Congress for inclusion of any such areas in the National Wilderness Preservation System." While Section 603 of Federal Land Policy and Management Act of 1976 requires that, pending congressional action, the BLM shall manage lands recommended for designation "so as not to impair the suitability of such areas for preservation as wilderness," Section 1320 of The Alaska National Interest Lands Conservation Act states that "in the absence of congressional action," the BLM shall manage the lands recommended for wilderness designation "in accordance with the applicable land use plans and applicable provisions of law." Consistent with Secretary Ken Salazar's June 1, 2011, memorandum to the BLM Director, in accordance with Federal Land Policy and Management Act of Section 201, the 2012 NPR-A Final IAP/EIS (BLM 2012, Section 4.3.18) described lands in the Reserve possessing wilderness characteristics and the potential impacts on those characteristics.

Section 105(c) of the Naval Petroleum Reserves Production Act directed that the Secretary of the Interior establish a task force to conduct a study for determination of the values, and best uses for, the lands contained within the NPR-A. In 1977–78, a field study was completed throughout the NPR-A in compliance with Section 105(c). The study included looking at the characteristics of wilderness values based on criteria from the Wilderness Act. Based on the 105(c) study and additional wilderness inventory reviews in 2002 and 2010 by the BLM's Arctic Field Office, wilderness characteristics and attributes in the NPR-A were further identified. The BLM is adopting the analysis of the 105(c) studies and the wilderness inventory reviews in 2002 and 2010 as a basis for analysis of wilderness characteristics in this plan (see **Table 3-40** and **Map 3-25**).

Direct and Indirect Impacts

The supplemental values of the planning area may contain ecological, geological, or other features of scientific, education, scenic, or historical value and could be affected if the climate continues to warm in the NPR-A (SNAP 2011, p. 5). A discussion of conditions related to climate change and impacts on wilderness characteristics is described in the 2012 NPR-A Final IAP/EIS (BLM 2012, Section 4.3.18).

The effects of climate change described above are part of the baseline conditions for wilderness characteristics in the project area. See **Section 3.2.1** for a detailed discussion of the alternatives' contributions to global climate change.

Table 3-40
Wilderness Characteristics Inventory Areas within the NPR-A Planning Area

Inventory Area	Acres	Associated Wilderness Characteristics
Colville River Valley	2,717,000	The area remains in a natural condition with the majority of use being for subsistence and recreation uses. Primitive recreation opportunities exist along the river.
DeLong Mountains/Arctic Foothills	1,904,000	The area provides many primitive recreation opportunities, and the 105(c) study found that it has the greatest scenic variety of any part of the NPR-A.
Ikpikuk River	3,678,000	The area generally appears to have been affected primarily by the forces of nature, with the imprint of man's work substantially unnoticeable. The area has outstanding opportunities for solitude or a primitive and unconfined type of recreation.
Kasegaluk Lagoon	544,000	This area is roadless and natural, with some impacts from human presence along the lagoon shoreline; it offers outstanding opportunities for primitive recreation endeavors.
NPR-A G and NPR-A H	6,732,000	The lands within a 5-mile radius around each village do not meet the criteria of naturalness; however, the rest of the lands do meet the criteria. There is opportunity for unconfined recreation.
Teshekpuk Lake Area	1,507,000	The Teshekpuk Lake area has opportunity for solitude. The area offers outstanding opportunities for scientific study and education and contains unique biological and geomorphological features.
Utukok River Uplands	5,006,000	The recreation value of the Utukok River includes the excellent opportunities to view wildlife, to float a river, and to hike within a natural arctic environment. The area provides opportunities for study of large natural floral and fauna communities.

Source: BLM 2012, Section 3.4.6

Alternative A

Under Alternative A, seismic survey work could continue in any area throughout the NPR-A. Wilderness characteristics of naturalness, outstanding opportunities for solitude or primitive and unconfined recreation, and scenic values would be affected from the noise of generator use, aircraft, and the increased human presence. The impact would be temporary and confined to the immediate area (i.e., within approximately 0.5 miles in any direction). A longer lasting impact could be on vegetation resulting from compaction due to seismic survey operations, which could affect naturalness and scenic values. Seismic operations by their nature do not follow the same routes every year, and the number of miles of the survey line run can vary greatly from year to year (BLM 2012, Section 4.3.18.2).

As part of production activities, an airstrip, camp facilities, and production well pads could be needed (**Appendix B, Section B.3**). While the intensity of impacts would be greatest during actual construction of these facilities, the remaining structures (i.e., roads and pads), human presence and associated activity, and noise would all affect wilderness characteristics during the life of the development.

Potential impacts on wilderness characteristics under Alternative A from oil and gas development would be reduced in the inventory areas being managed as closed to fluid mineral leasing (10,991,000 acres) or as open to fluid mineral leasing subject to the NSO stipulation (2,492,000 acres). Prohibiting surface-disturbing activities and new developments through the NSO stipulation would maintain the inventory area's apparent naturalness and opportunities for solitude or primitive and unconfined recreation. Wilderness characteristics would be eliminated on a site-specific basis should new roads be authorized; however, the inventory area would likely retain some of its overall wilderness character. Temporary and permanent access routes to a lease area traveled by developers would negatively affect the wilderness character of that inventory area.

Stipulations, BMPs, and ROPs would be implemented, which would provide protections from potential impacts on wilderness characteristics. BMP M-2 would prevent the introduction or spread of non-native, invasive plant species by requiring that equipment and vehicles be weed-free prior to entering the NPR-A, which would reduce impacts on naturalness.

The degree of potential impacts on wilderness character would depend on the intensity and specific locations of development, which would be further analyzed during the site-specific Application for Permit to Drill phase of development.

Impacts Common to All Action Alternatives

Wilderness characteristics consist of size, naturalness, and outstanding opportunities for solitude or primitive and unconfined recreation. They may also include supplemental values, such as ecological, geological, or other features of scientific, educational, scenic, or historical value. For all the alternatives, size is a characteristic that would not be affected; none of the alternatives would reduce any wilderness characteristics inventory areas to less than 5,000 acres.

Management actions associated with oil and gas activities that would affect the natural appearance of lands in the NPR-A would include the presence or absence of roads and trails, use of motorized vehicles on those roads and trails, seismic data acquisition using vibroseis trucks, construction of facilities and infrastructure for energy development, or other actions that result in or prevent surface-disturbing activities. All of these activities affect the presence or absence of human activity and, therefore, would affect an area's naturalness and opportunities for solitude in the NPR-A. Due to the relatively horizontal topography of the North Slope and elevation changes in the Noatak Wilderness and Gates of the Arctic Wilderness Areas south of the NPR-A, vast distances of the North Slope are viewable. Viewing oil and gas development in the NPR-A from the wilderness areas south of the NPR-A boundary would affect the wilderness experience associated with visiting an area where the imprint of humans' work is unnoticeable.

A discussion of impacts from non-oil and gas activities on wilderness characteristics is included in the 2012 NPR-A Final IAP/EIS (BLM 2012, Section 4.3.18). The characteristics of wilderness (i.e., naturalness, outstanding opportunities for solitude or primitive and unconfined recreation, and supplemental values) could be affected by non-oil and gas activities on a seasonal basis by activities such as archeological collection efforts, field camps, survey work, scientific research, recreation, film permits, hazardous and solid material removal, and overland moves. The seasonal impact of these activities on wilderness characteristics would be minimal due to the size of the planning area, the temporary nature of the activities, and the limited human intrusion. The supplementary values of wilderness characteristics (i.e., ecological, geological, or other features of scientific, educational, scenic, or historical value) would remain effectively unchanged. Overall, the impacts on wilderness characteristics from non-oil and gas activities would be negligible for the planning area.

Alternative B

Under Alternative B, potential impacts on wilderness character would be reduced in the inventory areas being managed as closed to fluid mineral leasing (11,334,000 acres) or as open to fluid mineral leasing subject to the NSO stipulation (3,791,000 acres); however, wilderness characteristics could be affected by development in wilderness inventory units adjacent to lands available for leasing, and surface occupancy could experience impacts on wilderness characteristics. Detrimental impacts on wilderness character would be similar to those described under Alternative A, but to a lesser degree due to more areas being closed to fluid mineral leasing and managed with NSO requirements under Alternative B. Stipulations and ROPs would be implemented, which would provide protections from potential impacts on wilderness characteristics as described under Alternative A. Overall, Alternative B would make 11,420,000 acres available for oil and gas lease sales in the planning area, which would adversely affect wilderness characteristics on fewer acres of wilderness inventory units than Alternative A.

Alternative C

Under Alternative C, potential impacts on wilderness character would be reduced in the inventory areas being managed as closed to fluid mineral leasing (5,701,000 acres) or as open to fluid mineral leasing subject to the NSO stipulation (5,013,000 acres); however, wilderness characteristics could be affected by development in wilderness inventory units adjacent to lands available for leasing, and surface occupancy could experience impacts on wilderness characteristics. Detrimental impacts on wilderness character would be similar to those described under Alternative A, but to a greater degree due to more areas available to fluid mineral leasing under Alternative C. Stipulations and ROPs would be implemented, which would provide protections from potential impacts on wilderness characteristics as described under Alternative A. Overall, Alternative C would make 17,053,000 acres available for oil and gas lease sales in the planning area, which would adversely affect wilderness characteristics to a greater extent than Alternative A due to more acres being available for oil and gas leasing in wilderness inventory units.

Alternative D

Under Alternative D, potential impacts on wilderness character would be reduced in the inventory areas being managed as closed to fluid mineral leasing (4,430,000 acres) or as open to fluid mineral leasing but subject to NSO requirements (4,653,000 acres); however, wilderness characteristics could be affected by development in wilderness inventory units adjacent to lands available for leasing, and surface occupancy could experience impacts on wilderness characteristics. Detrimental impacts on wilderness character would be similar to those described under Alternative A, but to a greater degree due to more areas available to fluid mineral leasing under Alternative D. Stipulations and ROPs would be implemented, which would provide protections from potential impacts on wilderness characteristics as described under Alternative A. Overall, Alternative D would make 18,324,000 acres available for oil and gas lease sales in the planning area, which would adversely affect wilderness characteristics to a greater extent than Alternative A due to more acres being available for oil and gas leasing in wilderness inventory units.

Cumulative Impacts

The cumulative impacts analysis period is from the 1970s through full realization of the hypothetical development scenario, which is anticipated to occur approximately 70 years after the ROD for this EIS is signed. The ending date is based on the assumption that oil and gas fields will be discovered and developed in the planning area over approximately the remainder of the first half of this century and that production and abandonment activities could last for approximately 50 more years. The geographic area of analysis for cumulative impacts on wilderness characteristics is the planning area.

The current levels of surface-disturbing activities related to oil and gas development near the program area is expected to continue. As a result, surface-disturbing activities affecting the indicators for wilderness characteristics on wilderness inventory unit lands within the planning area would also continue along current trends.

The types of RFFAs that could affect wilderness characteristics in wilderness inventory units would be similar to past and present actions. Reasonably foreseeable future oil and gas projects that could affect wilderness characteristics within the planning area include Alpine Colville Delta-5, GMT1 and GMT2, Willow, the Coastal Plain Oil and Gas Leasing Program, Nanushuk, and Greater Prudhoe Bay/Kuparuk; see **Appendix F**, **Section F.3.2** for more discussion of these RFFAs. These actions would add activities and structures that would cause impacts similar to those described under *Impacts Common to All Action Alternatives*, above.

All action alternatives would incrementally contribute to potential cumulative effects on wilderness characteristics from post-leasing oil and gas activities. Alternative B would have the lowest incremental contribution to potential cumulative impacts because more areas would be closed to fluid mineral leasing and managed with NSO requirements. Alternative D would have the greatest incremental contribution to potential cumulative impacts because the most acres would be available for leasing without NSO stipulations.

3.4.9 Visual Resources

Affected Environment

The BLM is responsible for ensuring that the scenic values of public lands are considered when providing for various uses. BLM management of visual resources is guided by its visual resource management (VRM) system. Key regulatory considerations involving visual resources include the following:

- Federal Land Policy and Management Act of 1976, 43 U.S.C. 1701 et. seq.;
  - Section 102 (a)(8). States that "...the public lands be managed in a manner that will protect the quality of the...scenic...values...."
  - Section 103 (c). Identifies "scenic values" as one of the resources for which public land should be managed.
  - Section 201 (a). States that "The Secretary shall prepare and maintain on a continuing basis an inventory of all public lands and their resources and other values (including...scenic values)...."
  - Section 505 (a). Requires that "Each ROW shall contain terms and conditions which will... minimize damage to the scenic and esthetic values...."
- NEPA of 1969, 43 U.S.C. 4321 et. seq.;
  - Section 101 (b). Requires measures be taken to "...assure for all American...esthetically pleasing surroundings...."
  - Section 102. Requires agencies to "Utilize a systematic, interdisciplinary approach which will ensure the integrated use of...Environmental Design Arts in the planning and decision making...."
- The NPRA of 1976 provides that the Secretary of the Interior "shall assume all responsibilities" for "any activities related to the protection of environmental, fish and wildlife, and historical or scenic values" (42 U.S.C. 6503(b)). Furthermore, the Naval Petroleum Reserve Production Act, as amended, contains special provisions that apply to any exploration or development activities within

areas "designated by the Secretary of the Interior containing any significant subsistence, recreational, fish and wildlife, or historical or scenic value" (42 U.S.C. 6504(a)). There are five such areas: the Teshekpuk Lake Special Area, Utukok River Uplands Special Area, Colville River Special Area, Peard Bay Special Area, and Kasegaluk Lagoon Special Area. Any oil and gas exploration or development within a special area "shall be conducted in a manner which will assure the maximum protection of such surface resources to the extent consistent with the requirements of [the] Act for the exploration of the Reserve" (42 U.S.C. 6504(a)). Finally, oil and gas activities must include or provide for "conditions, restrictions, and prohibitions as the Secretary deems necessary or appropriate to mitigate reasonably foreseeable and significantly adverse effects on the surface resources of the NPR-A" (42 U.S.C. 6506a(b)).

Relevant issues identified during internal scoping include the following:

- There are not many visual impact concerns.
- There may be a need to look at nighttime lighting impacts, particularly from exploratory drilling. There are standard lighting BMPs that are being implemented.

Relevant issues identified during public scoping include the following:

- Current limitations on petroleum development within Teshekpuk Lake Special Area, Colville River Special Area, Kasegaluk Lagoon Special Area, Utukok Uplands Special Area, and Peard Bay Special Area should be maintained to ensure maximum protection for key natural areas, wildlife habitat, subsistence use, recreation (including hunting and fishing) and scenic values.
- Part C of the Clean Air Act recognizes the importance of protecting air quality of areas with unique wildlife and recreational values, such as the ANWR and that the Clean Air Act establishes the need to "preserve, protect and enhance the air quality ... areas of natural, recreational, scenic or historic value…"
- A new plan [IAP] must ensure that any development in the Western Arctic Reserve includes lasting protection for key natural areas, wildlife habitat, subsistence use, recreation, and scenic values and include careful monitoring under a well-funded program of oversight and enforcement of environmental protection laws and regulations.
- Lands in and adjacent to the Brooks Range are highly scenic. This area should all receive consideration in any plans for development. Given Congress' understanding of the values of the Reserve, the Naval Petroleum Reserves Production Act mandated that any exploration in ecologically significant areas be done to "assure the maximum protection of such surface values…"

Existing VRM inventory conditions (scenic quality, visual resource sensitivity, and visual distance zones) are described in the Affected Environment chapter of the 2012 NPR-A Final IAP/EIS (BLM 2012, Section 3.4.9). Visual resource inventory (VRI) classes are assigned through the VRI process. VRM classes are assigned to BLM-managed surface lands through resource management plans.

Landscape conditions have changed since the 2012 NPR-A Final IAP/EIS. Greater Moose Tooth 1 and 2 oil development facilities were constructed and began operations in northeast NPR-A on Alaska's North Slope. They involve multiple wells, drilling pads, roads, and pipeline facilities. Although these two oil developments do not necessarily constitute a trend of converting undeveloped landscapes in the NPR-A, it would be more likely that future developments would lend evidence in support of a trend of permanently converting undeveloped landscapes in the NPR-A. The conversion trend involves the phased transformation of undeveloped areas with artificial structures and features.

Climate Change

Existing climate change influences on visual resources are described in the Affected Environment chapter of the 2012 NPR-A Final IAP/EIS (BLM 2012, Section 3.4.9). Also, **Sections 3.2.5**, **3.2.9**, and **3.3.1** above provide climate change information regarding climate warming, melting permafrost, and coastal erosion. These, and other changes, affect visual resources by changing, for example, landscape forms and vegetation composition.

Direct and Indirect Impacts

Every action has the potential to alter visual resources. This analysis, however, is for planning-level actions that occur in the decision area. When actions are analyzed at this scale, their magnitude of impact on visual resources is focused on broad changes to the characteristic landscape. See Section **F.4.27** in **Appendix F** for analytical methods used in this analysis.

Oil and gas actions involve leasing, exploration, development, production, and abandonment and reclamation. All actions on BLM-managed surface lands in the decision area must conform with VRM class objectives. As a result of leasing, however, exploration, development, and production involve the greatest opportunities to alter the scenic quality, which is used to establish VRI classes. Scenic quality can be altered by changes to the form, line, color, and texture of the landform or vegetation from surface disturbances; the presence of construction equipment and vehicles; or the construction of buildings, structures, and infrastructure. It can also be altered by the generation of dust, introduction of artificial light or glare, or operations (such as those that involve flaring or visible water vapor plumes). Similarly, activities not associated with NPR-A oil and gas exploration and development can also have impacts on altering the scenic quality. For example, the scenic quality can be altered by changes to the form, line, color, and texture of the landform or vegetation from surface disturbances associated with seismic surveys of unleased areas. Also, pipelines transporting oil and gas from offshore leases and construction of community infrastructure can add artificial elements to undisturbed areas, thereby affecting scenic quality. Activities not associated with NPR-A oil and gas exploration and development on BLM-managed surface lands in the decision area must also conform with VRM class objectives.

Conformance with VRM class objectives would be determined by completing the visual resource contrast rating (BLM Handbook H-8431-1) for oil and gas actions. The visual resource contrast rating could recommend mitigation measures, such as painting infrastructure colors that blend in with the surrounding landscape or using infrastructure composed of material colors that blend in with the surrounding landscape.

The VRI classes form the basis for analysis in this section. VRI classes are used to identify the relative importance of different landscapes in the decision area. Potential impacts on visual resources are assessed by comparing the VRI class to the VRM class assigned for an area. **Table 3-41** below lists how visual resources would be managed for each VRI class for the alternatives, and **Maps 2-12** through **2-15** in **Appendix A** show the VRM classes for the alternatives.

Lands classified as VRI Class I or Class II represent landscapes with high visual value. This is the result of a landscape having higher visual variety leading to a higher scenic quality rating. These landscapes commonly have higher public sensitivity rating. As such, lands classified as VRI Class I or Class II have the potential to experience a greater magnitude of impact from VRM Class III or Class IV management than lands

Table 3-41
Visual Resource Management for Visual Resources by Alternative

Alternative A acres	VRI Class I	VRI Class II	VRI Class III	VRI Class IV
VRM Class I	0	0	0	0
VRM Class II	0	3,986,000	2,948,000	1,418,000
VRM Class III	0	783,000	2,914,000	2,107,000
VRM Class IV	0	26,000	3,503,000	4,833,000

Alternative B acres	VRI Class I	VRI Class II	VRI Class III	VRI Class IV
VRM Class I	0	0	0	0
VRM Class II	0	4,545,000	5,974,000	3,717,000
VRM Class III	0	90,000	309,000	32,000
VRM Class IV	0	159,000	3,081,000	4,609,000

Alternative C acres	VRI Class I	VRI Class II	VRI Class III	VRI Class IV
VRM Class I	0	0	0	0
VRM Class II	0	2,828,000	4,149,000	2,002,000
VRM Class III	0	871,000	483,000	65,000
VRM Class IV	0	1,095,000	4,733,000	6,291,000

Alternative D acres	VRI Class I	VRI Class II	VRI Class III	VRI Class IV
VRM Class I	0	0	0	0
VRM Class II	0	2,828,000	3,917,000	1,821,000
VRM Class III	0	871,000	483,000	65,000
VRM Class IV	0	1,095,000	4,965,000	6,472,000

Source: BLM GIS 2019

classified as VRI Class III or Class IV. In other words, scenic quality may not be maintained when an area with a low VRI class number is assigned a higher VRM class number (e.g., VRI Class II managed as VRM Class III). This is because changes to the landscape would be allowed that conform with the higher VRM class number objective in an area that is actually capable of having a lower VRM class number according to the VRI. Conversely, scenic quality would be maintained when an area with a high VRI class number is assigned a lower VRM class number (e.g., VRI Class III managed as VRM Class II).

The effects of climate change described in the *Affected Environment* above, could influence the rate or degree of the potential direct and indirect impacts. The effects of climate change described under the *Affected Environment*, above, are part of the baseline conditions for visual resources in the project area. See **Section 3.2.1** for a detailed discussion of the alternatives' contributions to global climate change.

Alternative A

Under Alternative A, there would continue to be no VRM Class I areas. There would continue to be 809,000 acres of VRI Class II areas that are managed as VRM Class III or IV, which could degrade the scenic quality. Also, there would continue to be 3,503,000 acres of VRI Class III areas that are managed as VRM Class IV, which could also degrade the scenic quality. In total, there would continue to be 4,312,000 acres (19 percent of BLM-managed surface lands in the decision area) where scenic quality could degrade in VRI Class II and III areas.

Impacts Common to All Action Alternatives

There are no VRI Class I areas. As with Alternative A, there would be no VRM Class I areas under the action alternatives. There would be no impact on visual resources involving VRM or VRI Class I areas.

Alternative B

Under Alternative B, there would be 249,000 acres of VRI Class II areas that are managed as VRM Class III or IV, which could degrade the scenic quality. Also, there would be 3,081,000 acres of VRI Class III areas that are managed as VRM Class IV, which could also degrade the scenic quality. In total, there would be 3,330,000 acres (14 percent of BLM-managed surface lands in the decision area) where scenic quality could degrade in VRI Class II and III areas. Compared with Alternative A, this would create 982,000 fewer total acres where scenic quality could degrade in VRI Class II and III areas.

Alternative C

Under Alternative C, there would be 1,966,000 acres of VRI Class II areas that are managed as VRM Class III or IV, which could degrade the scenic quality. Also, there would be 4,733,000 acres of VRI Class III areas that are managed as VRM Class IV, which could also degrade the scenic quality. In total, there would be 6,699,000 acres (29 percent of BLM-managed surface lands in the decision area) where scenic quality could degrade in VRI Class II and III areas. Compared with Alternative A, this would create 2,387,000 additional total acres where scenic quality could degrade in VRI Class II and III areas.

Alternative D

Under Alternative D, there would be 1,966,000 acres of VRI Class II areas that are managed as VRM Class III or IV, which could degrade the scenic quality. Also, there would be 4,965,000 acres of VRI Class III areas that are managed as VRM Class IV, which could also degrade the scenic quality. In total, there would be 6,931,000 acres (31 percent of BLM-managed surface lands in the decision area) where scenic quality could degrade in VRI Class II and III areas. Compared with Alternative A, this would create 2,619,000 additional total acres where scenic quality could degrade in VRI Class II and III areas.

Cumulative Impacts

The cumulative effects study area is BLM-managed surface lands in the decision area; the cumulative impacts time frame for analysis spans from the 1970s through full realization of the hypothetical development scenario (**Appendix B**, **Section F.3.1**), which is anticipated to occur approximately 70 years after the ROD is signed. **Table F-1** in **Appendix F** lists the past, present, and RFFAs. The BLM manages 99 percent of the surface lands in the decision area (BLM GIS 2019). As such, visual resources would be largely influenced by activities on BLM-managed lands. Visual resources in the viewshed beyond the decision area would be influenced by activities on mostly private, state, and federal agencies.

Past and present actions that have primarily affected visual resources in the decision area are oil and gas exploration, development, and production; transportation infrastructure; and community development. These have modified the scenic quality of the landscape. For example, they have altered vegetation and landforms and have introduced artificial elements into the natural landscape. Some past developments are being reclaimed, and visual impacts are lessening.

Any RFFAs or projects that would disturb the surface can affect scenic quality. Proposed surface-disturbing projects can change landform, vegetation, color, and adjacent scenery.

When combined with past, present, and RFFAs or projects, Alternative A would continue to have no new cumulative impacts on visual resources. In total, there would continue to be 19 percent of BLM-managed surface lands in the decision area where scenic quality could degrade in VRI Class II and III areas.

When combined with past, present, and RFFAs or projects, Alternative B would have fewer cumulative impacts on visual resources than Alternative A, because 14 percent of BLM-managed surface lands in the decision area could experience a loss of scenic quality in VRI Class II and III areas.

When combined with past, present, and RFFAs or projects, Alternatives C and D would have greater cumulative impacts on visual resources than Alternative A, because 29 and 30 percent, respectively, of BLM-managed surface lands in the decision area could experience a loss of scenic quality in VRI Class II and III areas.

The effects of climate change described under *Affected Environment* above, could influence the rate or degree of the potential cumulative impacts.

3.4.10 Transportation

Affected Environment

Transportation and travel management decisions are described in the 2012 NPR-A Final IAP/EIS (BLM 2012, Section 3.4.10). Transportation and travel within the NPR-A are limited given the remote nature and rugged terrain of the region. Transportation networks created for the Prudhoe Bay Unit and Kuparuk River Unit in the North Slope would support NPR-A development activities. Collocated infrastructure from development activities for these units has permeated to the outer boundary of the NPR-A. Limited infrastructure exists outside of the North Slope developments, and oil and gas activities would expand from existing North Slope infrastructure. Land travel from the Dalton Highway through the North Slope and air travel through the Deadhorse Airport would be the primary access points for the NPR-A.

Road systems are summarized from the 2012 NPR-A Final IAP/EIS (BLM 2012, Section 3.4.10.1). The Dalton Highway serves as the primary road access way connecting the North Slope to central and southern Alaskan highways. The Dalton Highway is used for TAPS development activities but is also frequently used by tourists and recreationists to access the Arctic Circle. Development activities via overland travel for the NPR-A would use the Dalton Highway to access the North Slope transportation network. Concurrent use of the Dalton Highway by tourists and semi-trailer trucks is a concern for community members because there are limited emergency facilities or personnel to support travelers on the roadway (BLM 2002).

The North Slope transportation network developed for Prudhoe Bay/Kuparuk River Unit activities connects to the Dalton Highway via the Spine Road. The Spine Road crosses the Prudhoe Bay Oil Field and provides access to authorized users from Deadhorse to the Kuparuk Oil Field Base Camp and the Endicott Oil Field. There are security checkpoints on the oil field roads to ensure that only authorized personnel have access. While the Spine Road connects the oil fields, each field contains developed roadways extending from the region: the Prudhoe Bay Oil Field contains 200 miles of extending gravel roadways, Kuparuk Oil Field contains 94 miles of extending roadways, and Endicott contains 8 miles of extending causeways. During the winter, the NSB manages the Community Winter Access Trails project, consisting of approximately 300 miles of snow trails connecting North Slope communities to gravel roadways.

Villages in the region use and maintain community roadway networks that connect to other gravel and ice roads that also connect to the airstrip, community facilities, and other developments. For example, Nuiqsut is connected to the gravel road system via an ice road, and the BLM authorizes the NSB to develop a gravel roadway connecting Nuiqsut to the Colville River.

Air travel is a common form of transportation in the NPR-A. There are airstrips of various sizes and composition that are described in the 2012 NPR-A Final IAP/EIS (BLM 2012, Section 3.4.10.2).

Marine transportation primarily occurs via barge, with smaller craft used to access more inland communities. Shipments are contingent on ice-free access through the Arctic and primarily occur between July and September. Three dock heads are located at Prudhoe Bay, and one dock is located at Oilktok Point. No ports exist at Utqiaġvik or Wainwright, and supplies are offloaded at the beach or carried upstream by smaller craft. Nuiqsut is located inland, and supplies are brought in via smaller ships from the channel access point of the Colville River. Local villages use a variety of rivers for recreational or subsistence-based travel. Details of marine transportation for cargo or recreation/subsistence use are summarized from the 2012 NPR-A Final IAP/EIS (BLM 2012, Section 3.4.10.3).

Residents travel overland in the NPR-A via off-highway vehicles during summer conditions and snowmachine during winter conditions, where low-pressure vehicles are allowed. Subsistence users have unimpeded access to the entire NPR-A, but generally avoid travel in production areas. Exploration activities in the past have developed several miles of overland snow trails and ice roads. These routes are not public roads, as the holder of the ROW is held accountable by the BLM for any environmental damage. Approximately 415 miles of pipelines exist in the North Slope to connect TAPS to Prudhoe Bay, Milne Point, Endicott, Lisburne, Kuparuk, Badami, and the Alpine Field. Development in the NPR-A has required the development of one or more pipelines to connect with the pipeline system established at the North Slope. A detailed description of transportation systems and inaccessible areas is described further in the 2012 NPR-A Final IAP/EIS (BLM 2012, Section 3.4.10).

Climate Change

Transportation on the North Slope is subject to environmental variations, regulations, and social values. Increased volatility in weather patterns from climate change (SNAP 2018) will change transportation on the North Slope. Shorter winter seasons have required technological changes and regulatory constraints in snow trail and ice road construction. Technological changes are expected to meet transportation demand; however, more permanent networks may be construction should temporary roadways fail to meet demand.

Direct and Indirect Impacts

Potential impacts on transportation would be from management that increases or decreases opportunities for new transportation infrastructure, management of the timing, location, and type of vehicle use, and from changes in the level of public and subsistence use access in the program area. The magnitude, duration, and spatial extent of impacts on transportation would vary, based on the location and extent of transportation infrastructure, season and snow cover conditions, and other management, such as seasonal timing limitations for certain uses that would modify the nature of travel via certain modes.

Protective measures that specify the type and placement of new or expanded transportation infrastructure would affect the size, design, and location of the proposed infrastructure. For example, managing areas as NSO would preclude new transportation infrastructure. Lease stipulations that limit the placement of permanent transportation infrastructure, depending on season and snow cover conditions, would seasonally reduce private transportation opportunities for oil and gas development, while minimizing potential conflicts with the public and subsistence users.

The effects of climate change described under *Affected Environment*, above, could influence the rate or degree of the direct and indirect impacts. The effects of climate change described under the *Affected Environment*, above, are part of the baseline conditions for transportation in the project area. See **Section 3.2.1** for a detailed discussion of the alternatives' contributions to global climate change.

Alternative A

Under Alternative A, the planning area would continue to be managed as described in the 2012 NPR-A Final IAP/EIS (BLM 2012). No changes to the oil and gas leasing program would take place in the planning area; however, as current management allows leasing within the NPR-A, impacts on transportation would depend on the level of development allowed under this alternative.

Under Alternative A, approximately 11,763,000 acres are open for lease sales, of which 67.3 percent (7,920,000 acres) would be available for surface use and would allow for the construction of program-related roadways through the development and production phases consistent with the 2012 NPR-A IAP/EIS (BLM 2012).

Barge route transportation for the shipment of construction materials would be authorized under Alternative A consistent with the 2012 NPR-A IAP/EIS (BLM 2012). The magnitude of impacts associated with barge transport congestion and the development of barge landing locations would depend on the magnitude of lease sales.

Impacts Common to All Alternatives

Under all action alternatives, lease sales would likely result in an approximately equivalent number of gravel and ice roads, airstrips, fueling stations, and barge landing areas to support changes to oil and gas development within the NPR-A. In areas subject to NSO or unavailable for new infrastructure, new roads, airstrips, and other transportation-related infrastructure would not be developed.

Communities would have the ability to develop roadway infrastructure under all alternatives subject to mitigation requirements. This would include a community roadway connecting Nuiqsut and Utqiaġvik. Community roadway infrastructure would support the movement of people and goods within and between communities. The areas where new community infrastructure could be developed would be limited to areas that are closed to oil and gas leasing and development. In areas open to leasing with standard terms and conditions, the development of oil and gas infrastructure would limit the locations where community infrastructure could be developed. Community access to areas that may be developed is a major concern among community members (SRB&A 2009; BLM 1998c; BLM 2004f).

During the leasing phase, there would be no direct impacts on transportation as a lease does not authorize any on the ground oil and gas activities. Indirect impacts from post-lease activities would begin during the exploration phase, where increased usage of the Community Winter Access Trails may lead to traffic congestion, delayed travel times, and increased potential for roadway degradation. Exploratory activities would be isolated to existing gravel and ice roadways, as Lease Stipulation D-1 precludes the ability to develop new gravel roadways to support exploratory drilling. During the development phase, construction of new roadways infrastructure may be developed to access prospected locations. Intensification of impacts would increase throughout the development phase as construction related transportation would increase existing roadway use and traffic congestion. During the Production phase, the transportation of oil and gas production would occur throughout the planning area along road and barge routes. Transportation impacts would be associated with increased congestion of cargo carrying vehicles travelling through existing roadway networks near developed communities. Some roadway expansion may occur to support the development of new exploratory drill sites. Finally, during the abandonment and reclamation phase, existing roadways from the previous phases of development would be used to reclaim the area.

Under all alternatives, protective measures, lease stipulations, and ROPs would determine the location and extent of new or expanded roadways in support of the five phases of oil and gas development. Protective measures would require the free movement of caribou for subsistence purposes. Private transportation infrastructure developed to support the five phases of development would be closed to non-subsistence public users; therefore, there would be no increase in public access or connective networks with developed areas.

Across all action alternatives, barge route transportation may increase from changes to the leasing program. Intensification of impacts to barge route transportation would likely begin during the exploration phase to transport large equipment to the planning area, with possible barge landing locations at Atigaru Point, Smith Bay, or Utqiaġvik subject to further NEPA review (see **Appendix B**, **Section B.5**). Impacts would increase through the development and production phases, as increased construction and oil and gas production would require increased transportation of supplies and oil and gas cargo. Barges with supplies may experience increased congestion along the Dutch Harbor transportation route with increased oil and gas development activity within the NPR-A. The magnitude of barge transportation impacts would be associated with the availability of lands open to leasing and the associated development of oil and gas facilities.

Alternative B

Under Alternative B, impacts to travel and transportation infrastructure from the leasing program would be as described under *Impacts Common to All Alternatives*. During the exploration phase, Lease Stipulation D-1 would require developers to use ice roads and existing gravel roadways to access exploratory drill sites.

Reducing the lands available for lease sales to 11,420,000 acres, of which 66.8 percent (7,629,000 acres) would be available for surface use, would decrease opportunities where developers could construct new roadways through the development and production phases. Impacts would begin during the development phase as new roadways are constructed and continue through the production phase, where developers may expand prospected drill sites.

Compared with Alternative A, the smaller area available for leasing would result in slightly more areas where community roadway infrastructure could be developed.

Alternative B would result in two corridors within which pipeline ROWs would be allowed to facilitate the transportation of fluid mineral resources from the high hydrocarbon potential zone. Alternative B increases the land unavailable for new infrastructure to 10,537,000 acres (46.3 percent of the planning area), reducing the potential for the development of roadway networks for oil and gas transportation purposes.

With a reduction in lands available for leasing, Alternative B would reduce the impacts associated with barge route transportation compared with Alternative A. With less lands available for leasing, the potential for associated barge transportation impacts would be reduced.

Alternative C

Impacts on travel and transportation infrastructure from the leasing program under Alternative C would be as described under *Impacts Common to All Alternatives*. Increasing the lands available for leasing to 17,053,000 acres, of which 66.9 percent (11,418,000 acres) would be available for surface use, would increase opportunities where developers could construct new roadways. Compared with Alternative A, the larger area available for leasing would result in fewer areas where community roadway infrastructure could be developed.

Under Alternative C, there would be one corridor established within which pipeline ROWs would be allowed to facilitate the transportation of fluid mineral resources from the high hydrocarbon potential zone. Alternative C reduces the amount of land unavailable for new infrastructure to 5,133,000 acres (22.6 percent of the planning area), increasing the potential for the development of roadway networks for oil and gas transportation purposes compared with Alternative A.

With an increase in lands available for leasing, Alternative C would increase the potential for associated barge transportation impacts compared to Alternative A. Impacts would consist of increased barge transportation congestion and the potential for the development of barge landing facilities.

Alternative D

Under Alternative D, impacts on travel and transportation infrastructure from the leasing program would be as described under *Impacts Common to All Alternatives.*

Among all alternatives, Alternative D would open the most amount of lands for oil and gas leasing, approximately 18,324,000 acres (80.1 percent of the planning area). Alternative D would provide the most opportunities where developers could construct new roadways for oil and gas development and the fewest areas where community roadway infrastructure could be developed. Progression of impacts across the five phases of development would be the same as those described under *Impacts Common to All Alternatives.* The magnitude and locations where impacts on transportation would occur within the NPR-A would be greatest under this alternative.

Under Alternative D, there would no pipeline corridors to facilitate the transportation of fluid mineral resources. Instead, Alternative D provides the least amount of land unavailable for new infrastructure, approximately 4,531,000 acres (19.9 percent of the planning area), among all action alternatives. Lands made available for new infrastructure under this alternative are located within the high hydrocarbon potential zone, increasing the potential for roadway infrastructure to be developed to facilitate the transport of oil and gas related cargo.

With the most land available for oil and gas leasing, Alternative D would provide the highest potential for associated barge transportation impacts. However, as more lands are available for new infrastructure development under this alternative, developers may decide to construct new roadways to offset the need for barge transportation.

Cumulative Impacts

The geographic area of analysis for cumulative impacts on transportation is the planning area; the time frame for analysis spans from the 1970s through full realization of the hypothetical development scenario (**Appendix B**, **Section F.3.1**), which is anticipated to occur approximately 70 years after the ROD is signed. Cumulative impacts on transportation would be the result of past, present, and RFFAs that would increase or decrease opportunities for new transportation infrastructure, or change the level of public and subsistence use access in the planning area. Past, present, and RFFAs described in **Appendix B**, **Section B.5** that would cumulatively affect transportation include transportation projects, development of ROWs, and climate variability.

Impacts on transportation may increase from future oil and gas-related development near the planning area. Current oil and gas projects within the NPR-A, such as GMT1 and GMT2 and Alpine Colville Delta-5, coupled with reasonably foreseeable projects, such as Willow and Liberty, have the potential to affect transportation in the planning area by increasing the extent of the roadway network used for oil and gas and usage of those roads. They would also increase congestion along barge transportation routes. Vehicular access to the planning area is primarily through the Dalton Highway, and increasing oil and gas activity in the NPR-A may increase travel and shipment to the region, resulting in the potential for vehicle congestion along that roadway.

Under all action alternatives, future oil and gas development, coupled with increased recreation and mineral prospecting, would increase the potential for transportation-related impacts and conflicts with public access. Subsistence use and general public access conflicts would primarily be located near developed communities of the NSB, where established residential gravel, ice, and seasonal snow trails exist. Future oil and gas development would limit where communities could expand their community roadway infrastructure; this is because areas available for oil and gas leasing and development would preclude the development of new community roadway infrastructure.

The effects of climate change described under the *Affected Environment*, above, could influence the rate or degree of the potential cumulative impacts (SNAP 2018).

Climate change can uniquely change the transportation networks in the NPR-A, as ice and snow roads are heavily relied upon in winter conditions. Shorter winter seasons may affect the ability of developers relying on ice roads in accessing prospected locations during the exploration phase when gravel roadway development is prohibited. Combined with past, present, and RFFAs, it could also further limit the ability of communities to expand roadway infrastructure networks to support community needs.

3.4.11 Economy

Affected Environment

The entire planning area is contained within the NSB. Petroleum development in the NPR-A is expected to affect the communities in the North Slope, the NSB, and the State of Alaska. The communities that are considered to be most likely affected by oil and gas activities in the NPR-A are Anaktuvuk Pass, Atqasuk, Nuiqsut, Wainwright, and Utqiaġvik; although Anaktuvuk Pass is outside the planning area, oil and gas activities affect it. These are the communities that are currently eligible to receive grants from the NPR-A Impact Mitigation Fund. The NSB, the regional government entity, is also entitled to these funds; it has historically sponsored borough-wide projects with the grants. Other communities in the North Slope outside the planning area are also affected by activities in the planning area.

The 2012 NPR-A Final IAP/EIS provides a useful description of the area's economic structure and historical economic indicators with information through 2010 (BLM 2012, Section 3.4.11). This IAP/EIS provides an update of the socioeconomic conditions at the local level (NSB communities), the regional level (NSB), and the state level. Specifically, this section provides the latest available data on population, employment, income, and government revenues.

Population

Table W-1 in **Appendix W** shows the Alaska Department of Labor and Workforce Development's population estimates from 2010 to 2018 for the potentially affected areas (ADOLWDa 2019). Nearly half of the NSB region's population lives in Utqiaġvik, which is the service, transportation, and administrative center of the region. The community of Nuiqsut, which is the closest community to the existing oil and gas activities in the NPR-A, has seen the highest increase in population among the North Slope communities. Its population has grown from 402 to 499 (24 percent growth) from 2010 to 2018. Other communities in the North Slope with significant population growth over the 2010 to 2018 time frame include Point Lay (22 percent increase), Anaktuvuk Pass (15 percent increase), and Utqiaġvik (7 percent increase). The rest of the communities in the region had modest changes in population of less than 5 percent over the same time frame. The NSB region's population fluctuated from 2013 to 2016 but has since increased at a modest rate of 1 percent per year; statewide population has been decreasing since 2016 at less than 1 percent per year.

Population estimates from the 2015 NSB Census Report, which was based on a head count estimate to determine the population of communities that have less than 1,000 residents, showed that 2015 population estimates for the NSB communities were higher compared with the Alaska Department of Labor and Workforce Development's estimates for the same year (NSB 2015). **Table W-2** of **Appendix W** shows these estimates.

Employment and Income

Table W-3 in **Appendix W** shows the most recent data available on total employment and wages by community (ADOWDb 2019). The majority of the resident workers in the North Slope communities are employed in the local government sector (primarily the NSB and the city governments); 57 percent in Utqiaġvik and 86 percent in Point Lay are employed in the government sector. Utqiaġvik has the highest number of resident workers and the highest private sector employment among the communities, with 43 percent of its resident workers employed in the private sector. Outside Utqiaġvik, the communities of Point Hope, Wainwright, and Nuiqsut have the next highest number of resident workers and total wages among the communities. The village corporations and the ASRC and its subsidiaries provide most of the private sector employment in the communities.

Unemployment rates for the North Slope have increased since 2015, from 5.7 percent to 7.0 percent in 2018 (ADOLWDc 2019). The NSB Census Report, however, indicates the unemployment rate for NSB residents was significantly higher at 27.7 percent, based on respondent interview data collected for the 2015 Census (NSB 2015).

Local Economy: Nuiqsut

This section provides more detail on Nuiqsut, the closest community to the existing oil and gas activities in the NPR-A. The economy of Nuiqsut is primarily based on subsistence hunting, fishing, and whaling (ADCCEDa 2019). Most of the residents (81.5 percent of the population) are Iñupiat Eskimo (NSB 2015). Approximately two-thirds of Nuiqsut residents are shareholders in Kuukpik Corporation or ASRC, or both; these shareholders receive dividend income from these corporations. There are a few local retail and service-based businesses (six active business licenses) operating in the community, including the Native Village of Nuiqsut, the Kuukpik Hotel, West Wind Rental, and Nanuq (ADCCEDa 2019).

Since the discovery of the Alpine field by ConocoPhillips Alaska, Inc. in 1996 and more recent exploration and development activities in the NPR-A (i.e., GMT1, GMT2, and Willow), Nuiqsut and its village corporation, the Kuukpik Corporation, have experienced additional economic opportunities. The Alpine development has provided a number of economic and employment opportunities, including contracts to several Kuukpik Corporation joint ventures/subsidiaries. The Kuukpik Corporation and its partners (Kuukpik/Arctic Services, LLC; Kuukpik/LCMF; Kuukpik/Carlile Transportation, LLC; Kuukpik Drilling, LLC; Nanuq, Inc.; and Kuukpik/NANA Management Services, LLC) are involved in several projects, including gravel mobilization, pipe transportation, placement of pipe and facilities, and pipe welding and transportation (Kuukpik Corporation 2018).

Table W-4 in Appendix W shows local employment by sector in Nuiqsut. While the local government sector employs most of the local workers (62 percent), there are also jobs in other sectors, such as construction, trade, transportation, utilities, and professional and business services sectors (ADOLWDd 2019).

Regional Economy: NSB

A description of the existing economic conditions in the NSB are provided in the Draft Coastal Plain Leasing Program EIS, which is incorporated by reference (BLM 2018, Section 3.4.10). The NSB region's history, culture, and government are also described in detail in the NSB Comprehensive Plan 2019–2039 (NSB 2019).

The North Slope is home to Alaska's major oil production facilities (i.e., Prudhoe Bay, Kuparuk, Alpine, and others); here, most of its workers are nonresidents commuting from other areas in Alaska and from outside Alaska. The North Slope has the highest concentration of oil industry workers in the state, accounting for 66 percent of total statewide oil industry jobs (ADOLWD 2018e); however, as of 2017 only 20 oil industry workers were residents of the North Slope (ADOLWD 2019f).

The NSB government is a primary employer of local residents in the region. **Table W-5** in **Appendix W** shows the employment by sector of NSB residents in 2016 (ADOLWD 2019g). The NSB has been successful in creating employment opportunities for local residents and has hired locally for construction projects and operations, including education, safety, and medical services.

State Economy

The oil and gas industry is the largest component of the Alaska economy, contributing 10 percent of the state's total gross domestic product (GDP) in 2017 (BEA 2019), the highest among all industries in Alaska. In 2018, the oil and gas industry employed 9,365 workers in Alaska; this does not include the thousands of indirect jobs in security, catering, accommodations, facilities management, transportation, engineering, and logistics that support the oil and gas industry but are not categorized as oil and gas jobs. Jobs in the oil and gas extraction sector are the highest paying jobs in the state, with an average monthly wage of $18,736 in 2018. Economic events affecting the petroleum industry ripple through the state's entire economy. The impacts on the Alaska economy of the recent decline in oil prices are described in the Draft Coastal Plain Leasing Program EIS, which is incorporated by reference (BLM 2018, Section 3.4.10).

Government Revenues

At the local level, local governments in the North Slope generate revenues through local taxes and fees and receive outside funding through donations and grants from the State of Alaska, NSB, NPR-A Impact Mitigation Fund, and others. For example, the City of Nuiqsut receives local operating revenues from hotel and tobacco excise taxes, contracted services (Post Office), bingo receipts, rentals, and carbonated beverages sales/concessions; outside sources of funds include federal revenues from the NPR-A Impact Fund ($1.4 million), State community revenue sharing funds ($81,000), and NSB funds ($230,000). Outside sources account for 74 percent of the City of Nuiqsut's operating budget (see **Table W-6** in **Appendix W**). **Table W-7** in **Appendix W** shows the fiscal year 2018 operating revenues of the different NSB local governments by the source of funds (ADCCEDb 2019).

At the regional level, taxation of the oil and gas property provides the majority of the NSB government's revenue. Property taxes, assessed by both the State of Alaska and the NSB, provided about 91 percent of its general fund revenue in fiscal year 2018 (NSB 2018). Other revenue sources include charges for services, intergovernmental transfers (federal and state), and other sources, including investment income. The NSB provides a wide range of public services to all its communities, including infrastructure development. In fiscal year 2018, the NSB's expenses on capital projects amounted to about $127 million (NSB 2018). As noted above, the NSB receives grants from the NPR-A Impact Mitigation Fund; the NSB has used these funds to address the needs of the villages and its residents in and near the NPR-A. For fiscal year 2020, the total amount recommended for the NSB from the NPR-A Fund is about $13.39 million for various projects for the communities of Utqiaġvik, Anaktuvuk Pass, Atqasuk, Nuiqsut, and Wainwright (ADCCEDc 2019).

The state government is highly dependent on petroleum revenues. In fiscal year 2018, general fund unrestricted revenues totaled $2.4 billion, with oil and gas revenues accounting for 80 percent of all unrestricted revenue. Unrestricted funds are available to fund general state activities and capital projects (ADOR 2018). Petroleum revenues include property taxes, corporate income taxes, production (severance taxes), and royalties, including bonuses, rents, and interests. In fiscal year 2018, petroleum revenues amounted to $1.94 billion; 52 percent of this amount was from royalties (ADOR 2018).

The State of Alaska receives revenues from oil and gas activities in the NPR-A, but these revenues are treated differently than those from state or other federal lands. Federal law requires that 50 percent of the lease sale revenues, royalties, and other payments be paid to the State of Alaska, and the other 50 percent be paid to the General Fund of the U.S. Treasury. All state taxes (production/severance, corporate income tax, and property taxes) also apply to petroleum activity in the NPR-A. The lease sale revenues from the NPR-A that are paid to the State go to the NPR-A Special Revenue Fund and are specifically used to offset adverse impacts on communities in and near the NPR-A that are affected by oil and gas activities in the leased areas.

An overview of the history of the NPR-A Mitigation Program, how the program is implemented, and the allocation of funds to the communities that are eligible for grants is presented in the latest report by the State of Alaska to the legislature (ADCCEDc 2019). **Table W-8** in **Appendix W** summarizes the NPR-A Impact Mitigation Fund allocation by community since the program started in fiscal year 1987. The amount of money available for grants has varied widely since the program began mostly because of the lease sales results. Given recent and future activities in the NPR-A (Alpine, GMT1, GMT2, and Willow), it is projected that these funds will significantly increase in the future and the grants will become important both to the State of Alaska and the communities in the North Slope that are affected by development in the NPR-A.

The 2012 NPR-A Final IAP EIS (BLM 2012, Section 3.4.11.5) and the Draft Coastal Plain Leasing Program EIS (BLM 2018, Section 3.4.10), which are incorporated by reference, describe in more detail the different petroleum revenues (taxes and royalties) that are generated by the NSB and the State of Alaska, and how some of these revenues flow from the federal government to the state government and then further to the local governments in the North Slope.

Climate Change

Climate change could negatively affect the economy of the North Slope because the communities are primarily located at or near sea level. Any increase in mean sea level or violent storms may require relocating part or all villages and subsistence camps; this would cause negative impacts on the villages, the NSB, and the state.

Direct and Indirect Impacts

This economic analysis quantifies the potential impacts on the economy from on-the-ground future leasing activities and the subsequent exploration, development, production, reclamation, and abandonment activities that could ensue following the implementation of the proposed management plan (IAP).

In addition to analyzing the impacts of post-leasing on-the-ground activities, this IAP/EIS also analyzes impacts of oil and gas activities not associated with a lease (e.g., seismic surveys of unleased areas and pipelines transporting oil and gas from offshore leases), as well as non-oil and gas activities (e.g., construction of community infrastructure and scientific activities). However, a quantitative analysis of these impacts is not provided since such an analysis would require specific information regarding timing, geographic scope, and costs of the activities.

Non-Oil and Gas Activities

As noted in **Chapter 2**, **Table 2-2** under all action alternatives, community infrastructure projects may be permitted, with appropriate mitigation measures. Community infrastructure projects may include projects that respond to community needs, such as roads, power lines, fuel pipelines, and communications systems, and are owned and maintained by the NSB, city government, State of Alaska, a tribe, or an ANCSA corporation. For example, all action alternatives would allow for a potential community road connecting Nuiqsut and Utqiaġvik that is routed north of Teshekpuk Lake.

Construction and operations of community infrastructure projects would provide additional employment opportunities and increase income in the region. Such projects would also provide North Slope communities improved access to infrastructure and services and could also result in a lower cost of living in the long run.

Other non-oil and gas activities, such as mining activities, gravel transportation, and research activities, would continue to generate current levels of employment and income as described in the *Affected Environment* section.

Post-Leasing Oil and Gas Activities

The quantitative analysis provided in this section is focused on the impacts of post-leasing oil and gas activities (i.e., exploration, development, and production) that are described in the RFD section of the EIS.

It should be noted, however, that there are also economic effects resulting from activities that are not associated with an NPR-A lease (for example, seismic surveys of unleased areas and construction of pipelines in the area). As noted in **Chapter 2**, all alternatives allow for applications to construct permanent onshore oil and gas infrastructure to support development of leases in adjacent areas, such as pipelines and similar gas-related infrastructure, necessary for owners of offshore state and federal leases to bring oil and gas across NPR-A to the Trans-Alaska Pipeline System. Locations of this infrastructure would be limited by infrastructure and corridor management prescriptions contained in lease stipulations and ROPs under the specific alternative. These activities also provide employment opportunities and increase income at the local, regional, and statewide levels.

The potential economic effects of the post-leasing oil and gas activities would vary across the alternatives being considered and would primarily depend on the level and scale of development activities associated with each alternative. These are described in detail in **Sections B.8** and **B.9** of **Appendix B**. As noted in the RFD, under each of the alternatives, a low, medium, and high development scenario are considered with varying reasonably foreseeable assumptions regarding peak oil production, the number of central processing facilities, satellite pads, seawater treatment plants, and barge landings, as well as the length of roads and pipelines.

As noted in **Chapter 2**, **Table 2-2**, the different action alternatives consider a mix of lease stipulations and ROPs that contain measures to avoid or mitigate surface damage and minimize disturbance in the planning area. The resulting reduction in areas (acres) that would be open to fluid mineral leasing, subject to NSO and BMPs applied, would vary by alternative and are summarized in **Appendix B**, **Section B.9**.

The economic effects are evaluated with respect to employment, income, and government revenues at the local, regional, and statewide level.

To quantify the economic effects, the following assumptions and data sources were used as inputs to the economic and fiscal impacts models:

- The hypothetical development scenarios as described in the RFD provided the basis for modeling the potential petroleum development activities under the various alternatives.
- The RFD also described the typical timing for exploration, development, and production activities following a lease sale. For the purpose of this analysis, seismic exploration activities start right after the 2020 lease sale, followed by 10 years of further exploration, delineation, and development. First oil production is assumed to occur in 2030, which under the low development scenario would be from the first satellite pad, under the medium scenario would be from the one central processing facility, and under the high development scenario would be from the three central processing facilities. Development of the second satellite pad under the low development scenario would occur 2 years after the development of the first satellite pad; development of subsequent satellite pads under the medium and high development scenarios would occur every 2 years after development of the central processing facilities.
- Estimates of production volumes by year were based on the peak oil production estimates provided in the RFD and a production decline rate of 8 percent per year. This information was used to calculate potential royalty payments and other state and the federal government tax payments.
- Oil price projections were obtained from the Energy Information Administration's 2019 Annual Energy Outlook (EIA 2019). This information was used to quantify potential royalty payments and other fiscal effects.
- Construction and operating costs were estimated based on cost data from other North Slope development projects. This information was used to calculate direct and indirect employment and income effects of construction spending, as well as potential government revenues, including oil and gas property taxes and state corporate income taxes.
- Prevailing North Slope tariffs and transportation costs were used to calculate netback prices (oil prices at the wellhead), which are the basis for calculating royalty payments. Data on existing tariffs and transportation costs were obtained from the Alaska Department of Natural Resources.

The IMPLAN model for Alaska was used to estimate the potential direct and indirect employment and income effects of the various exploration, development, and production activities (MIG 2018). The cash flow model developed by the Alaska Department of Natural Resources (modified to fit the development and production assumptions used in this analysis) was used to generate the projected royalties and government taxes.

The effects of climate change described under the *Affected Environment* section, above, could influence the rate or degree of the potential direct and indirect impacts. The effects of climate change described under the *Affected Environment*, above, are part of the baseline conditions for the economy in the project area. See **Section 3.2.1** for a detailed discussion of the alternatives' contributions to global climate change.

Unconstrained Development Scenario

This subsection presents the results of the economic impact analysis of the unconstrained development scenario.

Future development under the low development scenario is assumed to include two satellite pads that would connect to existing and planned infrastructure in the Willow Development. Under the medium development scenario, in addition to satellite developments that would be added to the Willow Development, a new central processing facility and associated satellite pads at either the Smith Bay/Teshekpuk Lake area or Umiat would be developed. Under the high development scenario, 3 new central processing facilities and 20 satellite pads would be developed near Teshekpuk Lake and/or Smith Bay, in the Bear Tooth Unit, and in the area near Umiat.

Potential Employment Effects

Table W-9 in **Appendix W** provides the potential direct and indirect employment effects. The jobs associated with exploration, drilling, and construction activities are primarily seasonal and temporary in nature. Jobs associated with operations and maintenance of facilities (during the production phase) are mostly year-round and long term in nature; however, there would be some jobs associated with production activities that also would be seasonal in nature.

Under the low development scenario, it is estimated that peak employment could reach about 1,980 direct jobs during the exploration and development drilling phase, 2,930 direct jobs during the construction phase, and 120 direct jobs during the production phase.

Under the medium development scenario, peak employment would be roughly the same as the low development scenario during the exploration and development drilling phase (1,880 direct jobs), but higher peak employment (7,380 direct jobs) during the construction phase and production phase (930 jobs). The estimated peak employment during the exploration and development drilling phase is roughly the same as the estimated peak employment during low development scenario; however, under the low development scenario, the exploration and delineation phase would occur over a shorter period of time while under the medium development case, this phase would occur over 30 years. This is because under this development scenario, there would be 10 satellite pads that would be developed over this time period. Hence, the exploration and development drilling jobs would occur over a longer period of time compared with the low development scenario.

Under the high development scenario, it is estimated that peak employment could reach about 4,870 direct jobs during the exploration and development drilling phase, 8,580 direct jobs during the construction phase, and 1,530 direct jobs during the production phase. Like the medium development scenario, exploration, drilling, and construction activities would occur over a longer period of time with development of 3 central processing facilities and 20 satellite pads assumed to occur over the next 30 years.

Abandonment and reclamation activities that would occur at the end of the economic life of each field also would generate jobs. The total estimated direct jobs for abandonment and reclamation per anchor field are about 550 jobs, with an additional 520 indirect jobs. Each satellite field, on the other hand, is estimated to generate 160 direct jobs and 150 indirect jobs during reclamation and abandonment.

These jobs would be available for workers residing in the North Slope, other areas of Alaska, and outside Alaska. It is unknown at this time how many workers from North Slope communities and other Alaska communities would participate in the direct oil and gas activities. According to the Alaska Department of Labor and Workforce Development, over the past decade, the share of oil industry workers who are not Alaska residents has grown, ranging from 28 percent nonresident in 2009 to 34 percent in 2017. This percentage of nonresident workers could change in the future, depending on the availability of training programs and labor supply.

Oil field development projects in the North Slope typically require specialty tradesmen and construction workers with the skills and experience in ice roads, pipeline construction, facilities construction, and drilling. These jobs are typically held by nonresident workers; however, opportunities exist for North Slope residents that live near existing oil developments. Local residents have participated in oil and gas jobs, such as ice road monitors, camp security and facilities operators, and subsistence representatives. The Alaska Department of Labor and Workforce Development and the oil and gas industry have training programs geared toward developing the special skills required in oil field services. This is expected to create more employment opportunities for local residents.

Potential Income Effects

Table W-10 in **Appendix W** presents the estimated labor income associated with the jobs noted above, which would result from future exploration, development, and production of oil resources under the low, medium, and high development scenarios. The table shows projected direct and indirect annual average and peak labor income by phase.

As noted above, it is uncertain at this time how much of this total potential labor income would accrue to the local workforce, regional workforce, and Alaska workforce. Currently, about 36 percent of the total wages and salaries in the oil and gas extraction sector and 28 percent of wages and salaries in the oil field services sector go to out-of-state workers (ADOLWD 2018). It is possible that these percentages could change over time.

Economic Sectors

Industry spending during future exploration, development, and production phases would increase the level of activity in the Alaska economy, not just in the oil and gas extraction sector but also in other economic sectors, including oil field support services; construction, engineering, environmental, and other professional technical services; air, water, ground, and pipeline transportation sectors; retail and wholesale trade sectors; rental and leasing sectors; warehousing; accommodations and food services; and communications, information technology, management, and other business support sectors.

Potential Revenue Effects

Petroleum development in the planning area would continue to generate revenues to the federal government, the State of Alaska, and the NSB from royalties, taxes, and other fees. The projected revenues by revenue stream and by alternative are presented in **Table W-11** in **Appendix W**. The table shows the annual average revenues and the total cumulative revenues through year 2060.

At the local level, the City of Nuiqsut, which is the closest community to the existing petroleum development in the NPR-A, could potentially receive higher bed tax revenues from higher hotel occupancy during the leasing, exploration, and development phase, which would occur before the operations camps are built. The City of Nuiqsut currently has a 12 percent bed tax. The change in the level of hotel occupancy, however, is difficult to quantify at this point. The city also has a tobacco tax that could generate additional revenues for the city. Furthermore, the City of Nuiqsut would be eligible to receive funds through the NPR-A Impact Mitigation Grant Program, which is funded by royalty and other revenues from leases in the NPR-A. Other communities eligible to receive grants from the NPR-A Impact Mitigation Fund include Anaktuvuk Pass, Atqasuk, Wainwright, and Utqiaġvik.

At the regional level, the NSB government is anticipated to receive increased property tax revenues. The property tax would be based on the assessed valuation of the facilities developed on-site. The state property tax rate is 20 mills. A local tax is levied on the state's assessed valued for oil and gas property within a city or borough and is subject to local property tax limitations. The current tax rate for the NSB is 17.9 mills (hence, the state portion of the property tax is 2.1 mills). Property tax payments would start to accrue during the construction phase. Total cumulative NSB property tax revenues are estimated to amount to $1.1 billion under the low development scenario, $3.1 billion under the medium development scenario, and $6.8 billion under the high development scenario. The NSB also is entitled to funds from the NPR-A Impact Mitigation Fund and is anticipated to continue to sponsor borough-wide projects with the grant funds.

At the state level, there are several potential sources of revenues that future development in the NPR-A would generate. Production from the NPR-A would result in royalties paid to the federal government, and the State of Alaska would receive 50 percent of those royalties. The federal royalty rate is 16.67 percent of the wellhead value. The estimated cumulative state royalties would add up to $4.8 billion under the low development scenario, $14.8 billion under the medium development scenario, and $31.3 billion under the high development scenario. This estimated increase in royalty payments would result in additional money being made available to the communities that are eligible to receive funds from the NPR-A Impact Mitigation Fund. These funds would help support the infrastructure and public service needs of the communities in the North Slope.

Aside from the royalties, the State of Alaska would also receive property tax payments, severance (or production) taxes, corporate income taxes, and oil surcharge fees.

Property taxes on on-site facilities would start accruing during the construction phase. The production tax would apply to oil produced from the NPR-A and is based on the current tax rate of 35 percent of the production value, which is the value at the point of production, less all qualified lease expenditures (net value). Qualified lease expenditures include certain qualified capital and operating expenditures. State corporate income tax is calculated as 9.4 percent of the Alaska share of worldwide income for each corporation. The fiscal model, however, does not take into consideration corporate worldwide income (which is unknown at this time); rather, it simply evaluates all the costs and revenues and the resulting state income tax given the 9.4 percent income tax rate. The conservation surcharges apply to all oil production in Alaska and are in addition to production taxes. Revenues derived from these surcharges are intended to be used for oil and hazardous substance release prevention and response.

Total estimated cumulative state taxes from the revenue streams described above would amount to $12.9 billion under the low development scenario, $38.2 billion under the medium development scenario, and $80.6 billion under the high development scenario.

Alternative A

The reduction in area open to leasing compared with the unconstrained scenario discussed above, and the closure of the areas around Teshekpuk Lake and Smith Bay, would result in an estimated reduction in oil production of approximately 42 percent compared with the unconstrained projection. Peak production under the low, medium, and high development scenarios would be 69,000, 121,000, and 288,000 barrels of oil per day, respectively.

The magnitude of the economic effects under this alternative would be 42 percent lower compared with the magnitude of the economic effects presented in the unconstrained hypothetical low, medium, and high development scenarios.

Alternative B

Under Alternative B, there would be more areas unavailable for leasing and closed to new infrastructure compared with Alternative A. The reduction in area open to leasing compared with the unconstrained scenario, and the closure of the area around Teshekpuk Lake and Smith Bay, would result in an estimated reduction in oil production of approximately 48 percent compared with the unconstrained projection. Peak production under the low, medium, and high development scenarios would be 62,000, 109,000, and 259,000 barrels of oil per day, respectively.

The magnitude of the economic effects under this alternative would be 48 percent lower compared with the magnitude of the economic effects presented in the unconstrained hypothetical scenarios; it also would be lower compared with the magnitude of economic effects under Alternative A.

Alternative C

Alternative C would increase the total number of acres available for leasing compared with Alternative A. Compared with the unconstrained development scenario, the reduction in area open to leasing would result in an estimated reduction in oil production of approximately 27 percent with peak production of 87,000, 153,000, and 364,000 barrels of oil per day under the low, medium, and high development scenario, respectively.

The magnitude of the economic effects under this alternative would be higher compared with the magnitude of economic effects under Alternative A but would be 27 percent lower compared with the magnitude of the economic effects presented in the unconstrained hypothetical scenarios.

Alternative D

Alternative D would make the most land available for leasing and open to new infrastructure. The economic effects under this alternative would be higher compared with Alternative A. This alternative would reflect the unconstrained hypothetical development scenario; therefore, the estimated economic effects under this alternative would be the same as the estimated economic effects presented in the unconstrained hypothetical development scenario above.

Cumulative Impacts

The geographic scope of the cumulative impacts analysis is generally the North Slope region; however, some statewide analysis is also provided. The economic impacts of past and present oil and gas activities in the North Slope are accounted for in the *Affected Environment* section. Reasonably foreseeable future oil and gas activities not affected by the proposed IAP/EIS in the NPR-A and outside the planning area are described in **Section F.1.1**.

Production from newer development projects, such as Point Thomson, GMT1, GMT2, Willow, and Nanushuk, are expected to contribute to oil production in the next 10 years.

Point Thomson was brought online in April 2016, with production facilities designed to produce and reinject (cycle) 200 million cubic feet per day of gas and produce up to 10,000 barrels per day of natural gas condensate. This project opens the eastern North Slope to development and would lead to increased production into TAPS.

Project construction for GMT1 is well underway and already producing oil. Peak workforce at GMT1 during construction is estimated to be 700; the peak monthly production is estimated to be between 25,000 to 30,000 barrels of oil per day (gross). GMT2 could begin construction in early 2019, with first oil planned for late 2021. The development plan is for up to 48 wells, with 36 wells permitted initially. The project is estimated to cost $1.5 billion to develop, and peak production is expected to be 35,000 to 40,000 barrels of oil per day.

The master development plan for the Willow project was submitted to the BLM in 2018 to start the EIS process. The proposed action includes the construction, operation, and maintenance of a central processing facility; the construction of up to 5 well pads, with up to 50 wells on each pad; roads for field access and in-field transportation; an airstrip; a system of pipelines; and a temporary island in the Beaufort Sea to facilitate the delivery of modules for the project.

Willow is estimated to hold between 400 and 750 million barrels of recoverable oil equivalent, with peak production rates of about 100,000 barrels per day. The development is estimated to cost $2 billion to $3 billion over 4 to 5 years after a final investment decision is made. Oil production could start in the 2024 to 2025 time frame (Bailey 2018).

The Nanushuk field is one of the largest conventional onshore oil discoveries made in the U.S. in the past 30 years. Based on recent successful drilling in the Pikka Unit and in areas adjacent to Pikka and Horseshoe, Oil Search Alaska estimates that the potential resource in the Pikka Unit could be more than 700 million barrels. Oil Search Alaska plans to enter front-end engineering and design in 2019 and commence development of the Nanushuk field in 2020. The base development plan for the Pikka Unit Nanushuk development is now targeting first production in 2022 through a 30,000 barrels of oil per day early production system, using existing capacity in the processing facilities of an adjacent operator, followed by the development of dedicated facilities to manage production of approximately 120,000 barrels of oil per day (gross), allowing full field production to commence in 2024.

The oil and gas leasing program and subsequent exploration, development, and production activities in the program area would increase oil production in the North Slope; increase TAPS throughput; increase economic activity at the local, regional, and state level due to direct industry spending on labor, materials, and services; increase government revenues from shared royalties, tax payments such as property taxes, corporate income taxes, severance taxes, and other local taxes; increase job opportunities for Alaskans, including residents of communities in the NSB; and increase labor income in regions where industry spending would occur and where the oil and gas workforce would reside.

The potential cumulative impacts on the economy under the different alternatives would add to these potential impacts from other future development activities, but the magnitude of the economic effects would vary under the different alternatives. There will be differences in employment, income, and revenues due to differences in management and lease stipulations associated with the various alternatives.

The effects of climate change described under the *Affected Environment*, above, could influence the rate or degree of the potential cumulative impacts.

3.4.12 Public Health

Affected Environment

Data Sources

This analysis tiers to Section 3.4.12 of the 2012 NPR-A Final IAP/EIS (BLM 2012) and the community health report developed by the NSB as a baseline public health status for villages in the NPR-A (NSB 2012). This document updates information where possible, including use of the 2015 NSB census (NSB 2015), updated Alaska Department of Health and Social Services (ADHSS) vital statistics (ABVS 2018), Alaska

Behavioral Risk Factor Surveillance System (BRFSS) results (BRFSS 2017), epidemiology trends, and the ADHSS Nanushuk EIS human health baseline summary report (ADHSS 2018a).

The population of the NSB is small; when separated into villages, sample sizes decrease even more. Small populations mean small numbers of cases on an annual basis, with potentially large fluctuations from year to year. For this reason, rates of uncommon diseases or health conditions in the affected environment must be interpreted with caution.

Study Area and Population Demographics

The affected environment includes villages whose residents may be affected by social or environmental changes that result from changes to the BLM's management of the NPR-A. This includes the eight villages of the NSB (Anaktuvuk Pass, Atqasuk, Kaktovik, Nuiqsut, Point Hope, Point Lay, Utqiaġvik, and Wainwright) and most villages of the Northwest Arctic Borough (Ambler, Kiana, Noatak, Shungnak, and to a lesser extent, Kotzebue, Kobuk, Selawik, and Noorvik). **Table X-1** in **Appendix X** includes demographics for the above villages.

Section 3.4.3 identifies six primary subsistence study communities: Anaktuvuk Pass, Atqasuk, Nuiqsut, Point Lay, Utqiaġvik, and Wainwright. These communities are closest to the planning area and have subsistence uses in or near the planning area or rely heavily on resources that use the planning area. **Section 3.4.3** also identifies two other ties of subsistence users: 1) those who have peripheral or intermittent use of the planning area, and 2) those communities that harvest caribou that rely on the planning area for part of their life cycle, particularly the Western Arctic Herd and the Teshekpuk Caribou Herd. **Appendix T**, **Table T-1** provides a full list of the subsistence study communities and the associated map.

In this analysis, current health conditions are described more in depth for the NSB villages compared with the Northwest Arctic Borough. This is primarily because more specific and fine-grained data about health conditions exist for the NSB; however, the Northwest Arctic Borough communities share many common features with the NSB villages, including many lifestyle, environmental, social, economic, and cultural conditions that determine health outcomes. In addition, the RFD scenario forecasts potential development in the eastern portion of the NPR-A, which is part of the NSB (**Appendix B**, **Section B.4**).

Health Overview

NSB residents' leading causes of mortality from 2011 to 2013 were identical to the leading causes of mortality in the state: cancer, heart disease, unintentional injury, and chronic lower respiratory disease (ABVS 2018). Although the top four causes of deaths in the NSB from 2011 to 2013 were the same as the top four causes statewide, the age-adjusted rates for cancer, unintentional injury, and chronic lower respiratory disease were higher within the NSB (**Table X-2** in **Appendix X**; ABVS 2018). Suicide ranked as the fifth-highest cause of death in the NSB from 2011 to 2013 and was the sixth-highest cause of death in Alaska for that time period (ABVS 2018).

The NSB 2012 report tracks NSB death rates for the last several decades. Cancer and heart disease mortality rates have increased since the late 1980s. Chronic lower respiratory rates have increased since the mid-1990s, while unintentional mortality rates have declined during the same period (NSB 2012).

From 2013 to 2017, NSB residents surveyed for the BRFSS self-ranked their general health status, with 52 percent reporting very good to excellent health. This was similar to Alaskan adults overall (53 percent; BRFSS 2017). In the 1990s, NSB residents were more likely to report good health than other Alaskans. This shifted in the early 2000s when NSB residents were much less likely to report good health; this is reflected in Section 3.4.12 of the 2012 NPR-A Final IAP/EIS, where 46 percent of NSB residents reported good to excellent health compared with 56 percent of Alaskans (BLM 2012).

Health Effect Categories

The ADHSS Health Impacts Assessment Program has identified Alaska-specific key health effect categories to summarize information on characteristics that development projects may affect. These health effect categories address key health determinants, and they provide the basis for evaluating potential health effects and the framework for this analysis (ADHSS 2015).

Social Determinants of Health

Demographics

Table X-1 in **Appendix X** describes the population of the villages in the affected environment. There are two larger communities, Utqiaġvik and Kotzebue, but the majority of villages are small, with populations fewer than 1,000 residents. The majority of residents in all communities (roughly 80 to 90 percent except in Utqiaġvik and Kotzebue) are Iñupiat or Alaska Native. The population is young, with the median age between 18 and 29 years old and children comprising 30 to 49 percent of the population (**Table X-1** in **Appendix X**). This age structure influences the health conditions likely to be observed in the NSB, since younger populations are more likely to experience higher rates of infectious diseases, unintentional injuries, and some mental illnesses. Older populations, in contrast, tend to exhibit higher rates of chronic disease such as heart disease, diabetes, arthritis, and cancer.

The economy is one of the fundamental drivers of population health and wellness. Villages in the NPR-A face fluctuating employment markets with limited job opportunities and chronic levels of unemployment and underemployment. Economic indicators for NSB communities are discussed in **Section 3.4.11**, Economics.

Poverty has a strong negative impact on health due to chronic stress, poor nutrition, and problems with access to health care. From 2013 to 2017, 10.2 percent of NSB residents were below the poverty line, which is identical to the state poverty rate (U.S. Census ACS 2017).

Graduation rates for NSB communities ranged from 70 to 83 percent, all of which are lower than the state graduation rate of 92 percent (**Table X-3** in **Appendix X**). The Alaska Department of Education and Early Development reports the 2016–2017, 4-year adjusted graduation rate for the NSB School District as 78 percent and the Northwest Arctic Borough as 81 percent compared with 78 percent statewide (ADEED 2017).

Between 1999 and 2008, life expectancy at birth for a resident of the NSB was estimated as 71.9 years compared with 75.6 years for Alaskans overall, although the estimate was similar to that for Alaska Natives statewide (NSB 2012). NSB infant mortality rates have declined since their peak in 1978 to 1992 (NSB 2012), but remain twice the state rate (ADHSS 2018a). Low birth rates are also higher in the NSB than in the state (ADHSS 2018a).

Mental Health

Mental health is a critical component of overall health. From 2013 to 2017, NSB residents reported 3.4 days of poor mental health per month, which is identical to results for all Alaskans and slightly lower than Alaska Natives statewide (BRFSS 2017). Suicide has been one of the top five leading causes of death since 1992, including the period from 2011 to 2013 (**Table X-2** in **Appendix X**; ABVS 2018). Alcohol use was self-reported to be lower in the NSB (29 percent) than among Alaska Natives statewide (44 percent) and among all Alaskans (56 percent; BRFSS 2017); however, it continues to be a factor in injuries (NSB 2012). Tobacco use was reported as higher in the NSB (36 percent) compared with statewide (22 percent; BRFSS 2017).

Cultural Continuity

Cultural continuity has been linked to numerous positive health outcomes, including reduced rates of suicide (ADHSS 2018a). NSB communities identified speaking a native language and participating in subsistence activities as important indicators of community health and cultural continuity. In 2017, 32 percent of NSB residents spoke a language other than English at home (U.S. Census ACS 2017). Participation in subsistence activities is high throughout the NSB. In 2015, nearly 99 percent of NSB households participated in subsistence activities, and at least 95 percent of NSB Iñupiaq households reported consuming subsistence foods (NSB 2015).

Accidents and Injuries

Unintentional injuries were the third-leading cause of death in the NSB and statewide from 2011 to 2013 (**Table X-2** in **Appendix X**; ABVS 2018). Motor vehicle accidents were the leading cause of unintentional death followed by poisoning, which is typically caused by alcohol ingestion (ADHSS 2018a). Suicide was the fifth-leading cause of death in the NSB from 2011 to 2013, and it has remained a leading cause of death in the NSB for over two decades (ABVS 2018).

The Alaska Trauma Registry reports that the NSB has the highest rates of hospitalizations due to injuries in the state (141 per 100,000), over double the state average (BLM 2012). From 2011 to 2013, deaths due to injury were higher for the NSB compared with statewide rates by approximately 40 percent (**Table X-2** in **Appendix X**; ABVS 2018). High risk-taking behavior, much of which is associated with alcohol consumption, is thought to contribute to many injuries. The unique social and physical environments in Alaska's north also contribute to high injury rates (BLM 2012).

Exposure to Potentially Hazardous Materials

Residents of the NSB are concerned about environmental contamination, particularly as it relates to contamination of subsistence food sources. In a 2006 survey, 44 percent of Iñupiaq village residents reported concerns that fish and animals could be unsafe to eat (Poppel et al. 2007).

Exposure to air pollution was raised as a major concern by NSB residents during scoping, especially around Nuiqsut. A number of health conditions, including upper and lower respiratory diseases, are associated with exposure to air pollution. ConocoPhillips Alaska, Inc. operates an air monitoring station in Nuiqsut. Results from 2015 to 2017 do not exceed NAAQS or AAAQS. In addition, the ADEC reports monitoring values for short-term, project-specific air quality monitors used in the air permitting process. There are nine monitors on the North Slope, including ConocoPhillips Alaska, Inc.'s Nuiqsut Monitoring Station. None of the data from any of these monitors has shown exceedances of the NAAQS/AAAQS (ADEC 2018). See **Section 3.2.2**, Air Quality for information on air quality in the planning area.

Researchers also sampled air and water for volatile organic compounds in Nuiqsut using EPA methods. Over half of the air samples contained volatile organic compounds, though none of the volatile organic compound concentrations exceeded air quality standards and screened levels set by multiple federal agencies. volatile organic compounds specifically associated with crude oil development were either not detected or were found at low concentrations (below all standards and screen levels for all the collected samples). None of the water samples had volatile organic compound concentrations that exceeded ADEC water quality standards (ANTHC 2011).

Aside from actual exposure to environmental contamination, the perception of exposure to contamination is also linked with known health consequences. Perception of contamination may result in stress and anxiety about the safety of subsistence foods and avoidance of subsistence food sources, with potential changes in nutrition-related diseases as a result. The NSB regularly tests subsistence harvests to monitor the potential for contamination. According to NSB studies, contaminant levels are below levels of concern for human health (NSB 2019).

See **Section 3.2.11**, Solid and Hazardous Waste, for details on landfills, contaminated sites, and hazardous material cleanup sites within the NPR-A.

Food, Nutrition, and Subsistence Activity

Diets in the NSB include both subsistence and store-bought foods. Store-bought food in rural Alaskan villages tends to have low nutritional value, and the cost of buying nutritious foods is often prohibitively expensive. When subsistence resources become less accessible and people rely more heavily on store-bought foods, the nutritional value of the diet decreases, and the risk of chronic diseases increases. Diets composed primarily of subsistence harvests are associated with numerous health benefits and reduced risk of many chronic diseases, including diabetes, high blood pressure, high cholesterol, heart disease, stroke, arthritis, depression, and some cancers (BLM 2012).

In the 2015 NSB census, two-thirds of households indicated they get at least half of their meals from subsistence sources; over 99 percent of Iñupiaq households reported relying on subsistence resources to some extent (NSB 2015). For a detailed analysis of subsistence harvesting for the NPR-A communities, see **Section 3.4.3**, Subsistence Uses and Resources.

Food Security

Food security can be a source of stress in NSB households, particularly Iñupiaq households. Food security is based on the availability, access, and use of food and is related to health through malnutrition. NSB households, particularly Iñupiaq households, reported high levels of food insecurity in the NSB 2015 census. In the 2015 NSB census, 37 percent of household heads reported difficulty getting healthy food for meals, and 25 percent reported that there were times when there was not enough food to feed the household (NSB 2015). Food insecurity varied greatly between villages with Nuiqsut reporting only 9 percent food insecurity and Anaktuvuk Pass reporting 54 percent food insecurity (**Table X-4** in **Appendix X**; NSB 2015).

Food Sharing

NSB communities have strong sharing networks for subsistence resources. A smaller percentage of the households harvest the majority of subsistence resources used in a community. For Kaktovik and Wainwright, a study found that a household only harvested approximately 25 percent of the subsistence resources consumed in a year. This shows the sharing that occurs within and between communities and the importance of community to sustain a subsistence diet (ADHSS 2018a).

Infectious Diseases

Reportable infectious (communicable) diseases include tuberculosis, hepatitis, and diarrheal diseases, including giardiasis. Overall, the number of cases of infectious diseases reported in the NSB is low. Trends in reportable infectious diseases in the NSB are comparable with those occurring statewide except for sexually transmitted diseases (NSB 2012).

In 2018, the age-adjusted Chlamydia trachomatis rate was nearly three times higher for the northern region (includes the NSB, Northwest Arctic Borough, and Nome Census Area) than the rate statewide and higher than any other region in Alaska (ADHSS 2019). In 2012 and 2013, gonorrhea rates for the northern region were six to seven times higher than the rate statewide. In the last 5 years, gonorrhea rates have decreased in the northern region while increasing statewide. For 2017, gonorrhea rates were higher than the Alaska statewide rate, but only by approximately 50 percent (ADHSS 2018b).

Water and Sanitation

Unlike other remote areas in Alaska, the NSB has invested substantially to improve sanitation throughout the NSB. The NSB 2012 report states that 92 percent of NSB households had running water, and 91 percent had flush toilets (NSB 2012).

Noncommunicable and Chronic Diseases

Cancer and cardiovascular disease are the top two causes of death in the NSB. Age-adjusted rates for both were higher than the statewide rates (**Table X-2** in **Appendix X**; ABVS 2018). Due to the small sample sizes for the NSB, these numbers should be treated with caution. This is because large swings are possible in short time periods.

The most common cancers in the NSB are lung/bronchus, colon/rectum, prostate, and breast. These are also the most common four cancers across the state and the U.S. Age-adjusted rates of lung and colorectal cancers in the NSB for the years 1996–2007 are approximately double the national rates; however, rates of prostate and breast cancers are close to half the national rate (BLM 2012).

Cardiovascular disease prevalence has been increasing in the NSB, but death has been decreasing. This is likely due to improvements in medical intervention. Smoking, excess weight, and diabetes have increased in the NSB and are risk factors for cardiovascular disease (BLM 2012).

Overweight, obesity, and diabetes are linked with an increased risk of developing a number of other chronic health problems, including high blood pressure, heart disease, arthritis, certain cancers, and some types of respiratory problems. The prevalence of overweight or obese NSB residents from 2013 to 2017 was 73.7 percent, which was higher than for Alaska Natives statewide (68.2 percent) and for all of Alaska (66.5 percent; BRFSS 2017). Among NSB communities, the percentage of overweight residents in 2012 ranged from 17 to 36, and the percentage of obese residents ranges from 23 to 48 (**Table X-5** in **Appendix X**; NSB 2012).

Chronic lower respiratory disease is one of the most frequently cited health concerns among NSB community members (BLM 2012). It is the fourth-leading cause of death in the NSB and the state of Alaska (**Table X-2** in **Appendix X**; ABVS 2018). Several environmental factors trigger or exacerbate chronic lower respiratory disease symptoms, including exposure to tobacco smoke, exhaust from heating sources, and outdoor and indoor air quality. Arctic residents spend prolonged time indoors in houses with poor ventilation and that are tightly sealed and vulnerable to poor indoor air quality. High rates of smoking for NSB residents likely contribute to high respiratory disease rates (BLM 2012).

Health Services Infrastructure and Capacity

The U.S. Health Resources and Services Administration designated the NSB as a Health Professional Shortage Area for primary care providers (HRSA 2019). The NSB and Arctic Slope Native Association jointly provide health care serves for NSB residents; each NSB community maintains a clinic with community health aides. The Samuel Simmonds Memorial Hospital is located in Utqiaġvik and is a tertiary care center for the NSB villages. Cases are referred to Fairbanks or Anchorage if they cannot be adequately treated in Utqiaġvik.

Access to services is limited by the remote location of the villages, cost of travel, and severity of the climate. Many of the communities suffer from chronic health care workforce shortages and turnover (NSB 2012).

Climate Change

Further disruptions to subsistence patterns from global environmental and climatic changes could foreseeably have adverse effects on NSB residents' health, including changes to subsistence harvests; see **Section 3.4.3**. Changes to subsistence migration patterns and changing weather patterns and sea ice conditions could make travel more hazardous, increasing the risk of injury and trauma. According to an Alaska Native Tribal Health Consortium report on climate change in Nuiqsut, residents are noticing changes in weather, plants, animals, and the land; these changes are raising concerns about food and water security, transportation safety, and increased stress affecting mental health (ANTHC 2014).

Direct and Indirect Impacts

The analysis includes direct and indirect impacts from on-the-ground post-lease activities, other oil and gas activities in unleased areas, mining, infrastructure development, and scientific and other research and activity in the NPR-A. Potential impacts on public health and safety could stem from a number of different pathways: safety, diet and nutrition, environmental contaminants, economic impacts, increased stress levels, and changes to public health services. The RFD scenario is used to inform the analysis of public health and safety impacts for each alternative, but future analyses would occur with site-specific proposals.

The effects of climate change described in the *Affected Environment*, above, could influence the rate or degree of the potential direct and indirect impacts.

Impacts Common to All Alternatives

Activities Not Associated with Oil and Gas Exploration and Development

Activities not associated with oil and gas exploration and development are described in **Chapter 2**, **Section 2.2.6** and include aircraft use, river trips, other recreational uses, site cleanup and remediation activities, overland moves, archaeological surveys, site work, and community infrastructure projects, such as roads and pipelines.

Localized impacts on subsistence are possible, primarily as a result of displacement of animals as a result of aircraft noise. In addition, the presence of camps, whether or not they cause displacement of animals, may result in avoidance of the immediate area by hunters in an effort to minimize conflict. The effect of such activities is likely to be localized and temporary. Given the transient and highly localized nature of these activities, it is unlikely that there will be any measurable impact on public health at a population level.

Community infrastructure projects would occur close to existing communities and would be unlikely to impact public health. If the infrastructure projects include roads connecting separate communities, the roads could affect access to subsistence harvests (both positively and negatively) and the availability of subsistence species, particularly caribou. Impacts from potential roads between communities would be long term and could occur throughout the NPR-A where communities are present; however, measurable impacts on public health would not be expected.

Social Determinants of Health

All alternatives would be expected to result in increased revenues to the NSB and local NPR-A communities. Indirectly, these increased revenues would be expected to increase employment and incomes for NPR-A communities with potential benefits to community health; the majority of increases would occur during the development and production phases of a potential project (see **Section 3.4.11**).

Increased employment and income could help support subsistence activities, purchase food from stores, or both, and would assist with food security and nutrition. In addition, increased income has the potential to improve health in affected communities through increases in the standard of living, reductions in stress, and opportunities for personal growth and social relationships (BLM 2012).

There are potential negative impacts from economic growth. With other oil and gas development in the NSB, increased income and employment have been found to be associated with an increase in social disruption (BLM 2012). Not all residents would experience benefits related to increased employment and income associated with development of the planning area. In addition, the benefits of employment, especially in remote worker camps, are offset somewhat by tensions created between jobs in the wage economy and subsistence activities.

Most oil and gas industry jobs in the North Slope have gone to transient workers, and projected oil and gas development in the planning area is not expected to directly employ a large proportion of NPR-A residents. The BLM anticipates the primary employment and income impacts on NPR-A residents to be indirect as a result of increased revenues to the NSB and NPR-A communities, which allows for increased program spending and hiring. For a full description of socioeconomic impacts, see **Section 3.4.4**.

The BLM would not anticipate the alternatives to substantially change major health outcomes, rates of infant mortality, or low birth weights.

Oil and gas workers would be housed at on-site camps for all stages of development. Camp housing would have restrictions on drug and alcohol use, and interactions between oil and gas workers and NPR-A residents would be minimal outside of the oil and gas camps. The influx of workers would not be expected to increase drug, alcohol, or tobacco rates for NPR-A residents; however, increased incomes and revenue across the NPR-A are likely to be associated with some increase in alcohol and drug use.

Oil and gas development may have both beneficial and adverse impacts on mental health. The potential for increased revenue and employment may reduce stress and anxiety, but concerns about environmental contamination, potential impacts on subsistence access and resource availability, health impacts from spills, and other impacts from development, both real and perceived, could increase stress and disease susceptibility for some residents. Increases in stress could affect many social determinants of health, including substance abuse, domestic violence, and poor maternal and child health, which are already factors in NSB communities. Strong community ties would possibly mitigate some of the stress and reduce impacts. Since only a few NPR-A residents would likely work directly for oil and gas operators and housed outside NPR-A communities, impacts on community cohesion and from social isolation should be minimal.

Effects on social determinants of health from all stages of oil and gas development are complex, with a combination of probable beneficial impacts on nutrition and mental health from increased employment and income, but possible long-term impacts on mental health and general health status from increased stress levels.

Accidents and Injuries

Indigenous populations in the Arctic and elsewhere have high rates of accidents and trauma. The high incidence of accidents is partly due to the risks associated with subsistence activities, especially given the hostile environment of northern Alaska (BLM 2012).

Future post-leasing oil and gas development, non-oil and gas activities, and oil and gas activities in unleased areas have the potential to increase the risk of injuries and accidents during subsistence activities. The BLM expects post-leasing oil and gas development and oil and gas activities in unleased areas in the planning area to affect caribou herd movements and to alter subsistence hunting patterns for NPR-A residents. The disturbance of wildlife by industrial activity is likely to result in hunters traveling farther afield and possibly into unfamiliar terrain to harvest stocks. Nuiqsut residents have seen a change in subsistence use areas and changes in resource availability within traditional hunting areas, which have increased their travel time to and from subsistence activities. This has increased the potential for injuries and accidents (see **Section 3.4.3**).

Increased development may increase traffic along roads between Deadhorse and the planning area to transport personnel, goods, and equipment. This would increase traffic on oil industry roads that local residents sometimes use. Conflicts between NPR-A resident travel and industrial travel during construction and operations would increase the potential for accidents and injuries. ROP E-1 would minimize the impact of new and existing roads for NPR-A residents during travel and subsistence activities (**Chapter 2**, **Table 2-2**).

Under all the alternatives, the main impact on accidental injuries would result from either altered travel patterns or increased travel time for subsistence activity. Under all the alternatives, future development of fixed facilities in areas of traditional use is likely to result in voluntary displacement of subsistence. This potential impact would be most significant if large numbers of hunters avoid territory close to their homes. Any development in close proximity to a village would substantially increase travel distances and the subsequent risk of injury.

Exposure to Potentially Hazardous Materials

Air Quality

Section 3.2.2 describes the impacts of post-leasing oil and gas development, non-oil and gas activities, and oil and gas activities in unleased areas on air quality. The primary sources of airborne emissions are construction dust, road dust, vehicle and machinery emissions, flaring and venting of gas, burning of refuse, and emissions from power generation and other sources primarily during the exploration, development, and production phases of development. The air pollutants emitted by these activities have been linked with a range of health effects, including asthma, chronic bronchitis, decreased pulmonary function, and cardiovascular events (BLM 2012).

Both the EPA and the State of Alaska have established legal limits for air pollution to protect public health. Air quality changes are most likely to occur at and near the areas of post-leasing oil and gas development. If the development areas are distant from NPR-A communities, potential impacts on the health of residents as a whole are unlikely to be seen, and overall impact on human health is likely to be low. Those most likely to be affected are those who stay in cabins or other residences near development areas. In particular, dust from construction or traffic could be an issue. Since limited information exists to estimate air quality impacts for all alternatives, a site-specific analysis will be performed at the time a project is proposed based on the requirements in ROP A-10 (**Chapter 2**, **Table 2-2**).

Based on previous development projects and studies on the North Slope, the overall potential impact on human health is likely to remain low. This is because all alternatives are likely to be below applicable air quality standards for all phases of development (**Section 3.2.2**); however, people who are particularly vulnerable to respiratory problems (such as children, the elderly, and people with certain chronic illnesses) could experience health problems at locations or during episodes with poorer air quality.

Water Quality

As described in **Section 3.2.11**, post-leasing oil and gas development, non-oil and gas activities, and oil and gas activities in unleased areas could affect water quality through accidental spills or releases or as the byproduct of construction, excavation, or human habitation. The risk of accidental spills or releases would be highest during the exploration, development, and production phases of development. Water quality has the potential to affect the health of NPR-A residents through contamination of drinking water or through contamination of rivers and waterways near subsistence cabins or camps.

Water could be contaminated through accidental discharges into watercourses that supply human water sources, particularly in areas of cabins or transient subsistence uses of the land; however, the likelihood of any such discharge occurring with the resultant human exposure is low, given the lease stipulations and ROPs for waste prevention, handling, disposal, spills, and public safety. If exposure occurred under these circumstances, the exposure would likely be short term and intermittent; it would be unlikely to lead to significant health effects.

Contamination of Food Sources

Section 3.4.3 states that there is a low likelihood of contamination of subsistence food sources, with the possible exception of contamination through an oil spill. This is supported by current low measurable impacts, despite high levels of oil and gas activities on the North Slope in the past. Although studies have found elevated levels of contaminants in several species, the levels found in subsistence foods in the North Slope area appear at present to be generally low and are lower than what would trigger public health concern (NSB 2006). Except in the event of a major spill, there are likely to be only negligible health effects from contamination of food sources as a result of any of the alternatives.

Despite the low likelihood of contamination of traditional foods in the planning area, NPR-A residents remain concerned that oil and gas activities could potentially increase contaminant loads of subsistence foods to a level that would threaten human health. The perception of contamination may result in stress and anxiety about the safety of subsistence foods and avoidance of subsistence food sources with potential changes in nutrition-related diseases as a result. These health impacts (perceived or real) arise regardless of whether there is any contamination at levels of toxicological significance; the impacts are linked to the perception of contamination, not to measured levels. Monitoring contaminants in subsistence foods would help address subsistence user concerns related to contaminants, and it would identify potential human health issues.

Noise

Noise levels could increase due to post-leasing oil and gas development, non-oil and gas activities, and oil and gas activities in unleased areas, resulting in potential effects, ranging from minor irritation and annoyance to more severe health outcomes. Given the likely location of development away from NPR-A communities, individuals at cabins or camps near development would be most affected. Seismic exploration could occur across the entire planning area, not just those areas available for lease, and it could increase noise impacts on subsistence cabins or camps. ROP H-2 would require applicants to notify all potentially affected subsistence use cabin and campsite users prior to seismic activity (**Chapter 2**, **Table 2-2**). Noise impacts would be most likely to occur during development of potential projects with lesser impacts expected during exploration, production, and abandonment and reclamation phases.

Noise from future air traffic and other sources could create a nuisance around camps and cabins, possibly reducing their use as a base for subsistence harvests. While oil and gas development is a primary source of air traffic on the North Slope, other sources of air traffic include scientific and agency research, recreational uses, and commercial flights. Development-related noise could cause irritation, annoyance, or sleep disturbance among individuals who experience it (BLM 2012). Avoidance of subsistence use areas due to development activities has been documented in Nuiqsut and would likely occur for Atqasuk, Utqiaġvik, Point Lay, and Wainwright harvesters if development occurs in their harvesting areas.

Noise also could disrupt and displace caribou herds. This would result in changes to subsistence patterns with impacts as described under Accidents and Injuries, above. Residents on the North Slope have observed changes to caribou herd movements due to noise from helicopters, small aircraft, and seismic testing (SRB&A 2009). Until site-specific development activities are proposed, the extent of this effect is not possible to determine. ROPs F-2 to F-4 would minimize effects of low-flying aircraft on subsistence activities and local communities, reducing potential noise impacts from air traffic (**Chapter 2**, **Table 2-2**).

Food, Nutrition, and Subsistence Activity

Under all the alternatives, there would be mixed effects on diet and nutrition. Increased incomes may have a beneficial effect on NPR-A residents' ability to engage in subsistence activities and increase the ability to purchase foods from the store, thus reducing food insecurity (NSB 2012).

Dietary changes could result from the displacement or contamination of food sources, avoidance or loss of traditional harvesting lands, and increased reliance on store-bought foods. Consumption of traditional foods is associated with a reduced risk of chronic diseases, such as diabetes, hypertension, cardiovascular disease, and stroke (BLM 2012). Store-bought food in rural Alaskan villages tends to have low nutritional value, and the cost of buying nutritious foods is often prohibitively expensive. When subsistence resources become less accessible and people rely more heavily on store-bought foods, the nutritional value of the diet decreases, and the risk of chronic diseases increases.

In addition, 25 percent of NSB household heads reported times when there was not enough food for their household (NSB 2015). Studies have found a variety of adverse health impacts from food insecurity, including obesity, poor psychological functioning among children, poor cardiovascular health, and lower physical and mental health ratings. The costs associated with harvesting subsistence resources, the year-to-year variability in subsistence harvest, and the high cost of store-bought food all contribute to high rates of food insecurity. Increased incomes could provide more resources to support subsistence activities or purchase food from the store, resulting in improved food security and possibly nutrition.

As described in *Affected Environment*, above, Atqasuk, Nuiqsut, Point Lay, Utqiaġvik, and Wainwright are the primary users of the NPR-A and would therefore be most likely to experience changes to their diet and nutrition from changes in subsistence resource availability and access. However, Nuiqsut and Utqiaġvik show the most use of areas of high hydrocarbon potential within the NPR-A. Atqasuk and Wainwright have uses primarily within areas of medium and low hydrocarbon potential, and Point Lay has uses within areas of low hydrocarbon potential. Thus, while the likelihood of impacts is higher for Nuiqsut and Utqiaġvik, if post-leasing oil and gas development or oil and gas activities in unleased areas occur in areas of medium to low hydrocarbon potential, then the communities of Atqasuk, Point Lay, and Wainwright would also experience impacts at levels similar to Nuiqsut and Utqiaġvik.

The community of Anaktuvuk Pass has one of the highest reliances on caribou of all the study communities and relies on the migration of caribou from areas of high hydrocarbon potential into traditional harvesting areas; therefore, this community could be particularly vulnerable to changes in the availability of caribou and the resulting detrimental changes to diet and nutrition. The peripheral communities listed in the *Affected Environment* would more likely experience indirect impacts on subsistence uses if there are changes to the availability or abundance of terrestrial subsistence resources resulting from NPR-A development. In the case of the 42 communities who have documented uses of the Western Arctic Herd or Teshekpuk Caribou Herd, these communities could experience indirect or cumulative effects on health resulting from development of the NPR-A.

Infectious Diseases

None of the alternatives would result in a large influx of outside workers into NPR-A communities. Only a small number of NSB residents would be likely to work in the oil and gas fields, away from their family and community. Primarily, oil and gas workers would be housed in on-site camps with few interactions between oil and gas employees and NPR-A residents outside the camps. Increased rates of infectious diseases would be unlikely, but they could occur throughout all stages of oil and gas development. Development and production have the highest number of outside workers projected in the planning area (see **Section 3.4.11**).

Water and Sanitation

Oil and gas operators would provide on-site water and sanitation services for the worker camps. No changes in access to or cost of water and sanitation services in NPR-A communities would be anticipated by any phase of oil and gas development. Increases in NSB revenues could result in additional funding for water and sanitation facilities for NPR-A communities, if necessary.

Noncommunicable and Chronic Diseases

NSB residents have age-adjusted mortality rates higher than the state rates for cancer, cardiovascular disease, and chronic respiratory diseases. These diseases have a variety of risk factors, only a few of which might be affected by oil and gas development in the planning area. These include air quality, exposure to hazardous materials from spills, and chronic stress levels.

NSB residents have high levels of respiratory disease, and it was noted as a concern during scoping. Emissions linked to development activities and air quality in homes, especially particulate matter, have been linked to respiratory diseases and cardiovascular diseases (EPA 2009); however, as discussed above and in **Section 3.2.2**, air emissions from all phases of oil and gas development would be unlikely to degrade air quality to levels associated with health effects on NPR-A residents. Development and production phases would have the highest levels of emissions. ROP A-10 would require emission inventories and baseline air monitoring prior to any specific project developed in the planning area (**Chapter 2**, **Table 2-2**). Those results would be analyzed at the project level after the lease sales are complete. Based on other oil and gas development on the North Slope, it is unlikely that air emissions during any stage of post-leasing oil and gas development or oil and gas activities in unleased areas would reach levels that could increase respiratory or cardiovascular disease rates for NPR-A residents.

Another possible pathway for increased disease susceptibility in NPR-A residents would be large oil spills. The risk of a spill this size would be low, and required cleanup measures would include worker health protection and exclusion zones to minimize potential exposure to hazardous materials for NPR-A residents.

The NSB 2012 report notes that there are no known links between any stage of oil and gas development on the North Slope and chronic diseases. Impacts on rates of cancer, cardiovascular disease, or chronic respiratory disease would be unlikely.

Health Services Infrastructure and Capacity

Post-leasing oil and gas activities and oil and gas activities in unleased areas would occur outside NPR-A communities. Project workers would be provided first aid at the worker camp or be evacuated to urban areas for health care. An influx of oil and gas workers would not affect community health care services during any stage of development. There could be a slight increase in accidents due to changes in subsistence harvesting patterns, but these would be sporadic and well in the capacity of the local community clinics and Samuel Simmonds Memorial Hospital in Utqiaġvik.

Anticipated tax revenues from post-leasing oil and gas development under all alternatives would support the current level of health care services in the NPR-A communities, would allow for increased funding of existing health and social programs, and should not affect demand. Episodic increases in disease occurrence, such as respiratory disease resulting from poor air quality, have the potential to cause a short-term strain on the health care system; however, no such occurrences are likely under any alternative.

Climate Change

The effects of climate change described under the *Affected Environment*, above, are part of the baseline conditions for public health in the project area. See **Section 3.2.1** for a detailed discussion of the alternatives' contributions to global climate change.

Alternative A

Under Alternative A, the types of potential impacts on public health and safety would be the same as those described above (*Impacts Common to All Alternatives*). The duration of impacts would be long term, although certain specific impacts, such as those from seismic activity and construction noise, would occur only during the exploration and construction phases of individual development plans. Additional activities associated with community infrastructure projects, scientific and agency research, seismic surveys in unleased areas, and recreational activities would continue to occur throughout the NPR-A.

Under Alternative A, management of the NPR-A would continue as previously approved under the February 2013 NPR-A IAP ROD. Approximately 52 percent of NPR-A lands would be available for oil and gas leasing and infrastructure development, with large portions of land protected for surface resources. Due to their proximity to current development and areas of high development potential, Nuiqsut and Utqiaġvik would have the greatest likelihood of impacts on subsistence harvests, as discussed in **Section 3.4**. Subsistence changes could extend to Atqasuk, Point Lay, and Wainwright if development occurs in areas of low to moderate hydrocarbon potential; thus, they could experience impacts in the event that development extends into those areas. Any changes to subsistence harvests would increase the likelihood and severity of health impacts, resulting from changes in diet and nutrition, and would exacerbate the current trends away from a traditional diet. In addition, changes to caribou herd numbers or movement could increase the distance and time that NPR-A hunters travel. This would increase the potential for accidents or injury.

Post-leasing oil and gas development would continue to expand around Nuiqsut, and impacts on subsistence activities would continue to grow. This increased development could further reduce subsistence harvests, which would increase health impacts, increase perceived contamination concerns, and possibly increase the risk of injury. In addition, the feeling of being boxed in by development could increase stress for Nuiqsut residents with impacts as described under *Impacts Common to All Alternatives*.

Alternative B

The types of impacts from post-leasing oil and gas development, infrastructure development, and other activities in leased and unleased areas would be the same as those described under Alternative A and under *Impacts Common to All Alternatives*; however, the likelihood and magnitude of impacts on subsistence harvests would be less than those described under Alternative A. This would decrease the potential for health impacts from changes to diet and nutrition.

Under Alternative B, fewer acres would be open around Nuiqsut, which would reduce the potential impacts on subsistence harvests and the correlating impacts on diet and nutrition. Also, less development around Nuiqsut would reduce the pressure of development and would decrease stress levels compared with Alternative A. Impacts on Utqiaġvik, Atqasuk, and Wainwright would be similar to those discussed under Alternative A, but with less potential for subsistence impacts near their communities.

Because Alternative B would remove or defer a greater portion of the area of high hydrocarbon potential from oil and gas leasing compared with Alternative A, there may be some reductions in income for NPR-A residents and revenue for the NSB and NPR-A communities. It is unlikely that the potential decrease in income and revenue would have an impact on public health.

Alternative C

Under Alternative C, the number of acres available for oil and gas leasing would be higher than under Alternative A. As compared with Alternative A, the level of activity and the wide distribution of exploration and development under Alternative C would increase the likelihood and severity of health impacts resulting from changes in diet and nutrition. They would exacerbate the current trends away from a traditional diet. In addition, additional development near communities could change travel routes and increase travel time for subsistence hunters, increasing the potential for injury and accidents.

Projections for Alternative C include more development compared with Alternative A (**Appendix B, Section B.9**), which would result in higher income for NPR-A residents and revenue for the NSB and NPR-A communities. It is unlikely, however, that the potential increase in income and revenue would have an impact on public health.

Alternative D

Under Alternative D, the number of acres available for oil and gas leasing would be higher than under Alternative A, and the highest of any alternative. The only areas completely closed to mineral leasing would be in the western portion of the NPR-A in areas of low oil and gas potential. The increased development projections for Alternative D (**Appendix B**, **Section B.9.4.**) would have the greatest potential impacts on subsistence harvests with the greatest likelihood of health impacts. Under Alternative D, Nuiqsut hunters could, over time, become dependent on a severely limited land base for subsistence activity. They could become vulnerable to fluctuations in the success of harvests with variation in individual success rates and harvest amounts already reported by Nuiqsut subsistence users.

As with Alternative C, Alternative D would result in higher income for NPR-A residents and revenue for the NSB and NPR-A communities; however, no changes to public health impacts would be anticipated compared with Alternative A.

Cumulative Impacts

The cumulative effects analysis area for human health and safety extends beyond the NPR-A boundary and includes the three tiers of subsistence communities described in **Section 3.4.3.** This is due to potential impacts on subsistence harvests and subsequent effects on stress, safety, diet, and nutrition. The temporal scale spans from the 1970s through 70 years after the ROD is signed, as defined in **Section F.3.1** of **Appendix F**. Cumulative human health and safety effects on affected communities from past, present, and RFFAs likely would be mixed.

All alternatives would have similar contributions to the cumulative effects on public health for affected communities with the pathways described above. All alternatives would continue the ongoing transition from a subsistence-based diet to one that includes store-bought food. This is because post-leasing oil and gas development and other activities in leased and unleased areas could interfere with the success of subsistence activities due to the area available to subsistence use shrinking over time and long-term changes in subsistence use patterns. Increased infrastructure and activity in and around the planning area and in offshore areas could contribute to a feeling of being boxed in by development, particularly for Nuiqsut. This community has already reported feeling boxed in to the west, north, and east, with only the southerly direction relatively untouched by development and development infrastructure. The overall area available for subsistence use would likely shrink over time due to the increasing presence of infrastructure and human activity in traditional use areas.

While NPR-A subsistence users would adapt, to varying extents, to the changes occurring around them and may continue to harvest resources at adequate levels, their connection to certain traditional areas may decrease over time. Over time, reductions in subsistence harvests could have a negative effect on diet and nutrition and accelerate the transition from a subsistence-based diet to one that includes a higher proportion of store-bought food. Alternative B would lessen the potential negative impacts of post-leasing oil and gas development by closing the greatest area to development within the high development potential area. Alternatives C and D would allow the most widespread industrial activity, with resulting potential impacts on subsistence harvest efforts; they would accelerate the transition away from a traditional diet and the subsequent increases in health risks.

Current levels of contamination of traditional food and water supplies in the region are low and, in the absence of major spills or accidents, are unlikely to significantly change under any alternative. Perception of contamination, on the other hand, is already high. Extensive development, particularly in areas of traditional use and subsistence harvest as would be the case under Alternatives C and D, would increase the perception of contamination and may result in changes in stress.

Rates of accident injury are high for NPR-A residents. Disruptions to subsistence harvest patterns and conflicts between uses of the land can lead to an increased risk of injury in hunters. This is in addition to the risk of unpredictable weather and sea ice conditions associated with climate change. All alternatives would increase the likelihood of potential injury due to increased development in the eastern portion of the NPR-A; Alternatives C and D would allow the most widespread industrial activity with a greater potential to increase the risk of injury compared with Alternatives A and B.

Increasing economic development and revenues to the local governments under all the alternatives would support maintenance and improvement of NPR-A community infrastructure and systems. The direct and indirect employment resulting from oil and gas exploration and development, combined with the government and ANCSA corporation revenues, are major contributors to the positive health changes in the NSB over the last few decades. Increased employment and income can support subsistence activities and purchase foods, thus reducing food insecurity. The increased revenues have allowed the NSB to provide water, sanitation, and health care services and facilities that are absent in many other small rural communities in Alaska. The activities under all alternatives would contribute to these ongoing impacts, with greater levels of employment generally more likely to be associated with good health.

Increased oil and gas development has mixed impacts on stress levels for NPR-A residents, as described under *Impacts Common to All Alternatives*. Although there is no measurable evidence of impacts on public health from oil and gas development, NPR-A residents remain concerned. The primary difference in the contribution of the alternatives under consideration to the cumulative impact of stress would be related to how well they preserve the opportunity to engage in meaningful cultural and subsistence activities. Alternatives A and B, which would have large sections of intensively used traditional land unavailable for leasing, would be likely to help protect subsistence activity and maintain cultural ties. Alternatives C and D would have the potential to lead to widespread industrialization of the landscape that could restrict traditional activities and lead to conflicts between users, thus becoming a primary contributor to stress for NPR-A communities.

As discussed above, warming temperatures are affecting subsistence migration patterns and changing weather patterns and sea ice conditions. NPR-A residents face increasing stress adjusting to these changes and would likely face additional stress from the proposed alternatives and other planned development in the planning area. This increased stress could result in affected residents being more susceptible to health impacts.

3.5 UNAVOIDABLE ADVERSE EFFECTS

Unavoidable adverse effects would be expected to occur during oil and gas exploration, development, and production and other permitted activities under the alternatives considered in this EIS. Many adverse impacts could be lessened by Lease Stipulations and ROPs but would not be completely eliminated or reduced to negligible levels. Some are short-term impacts, while others may be long-term impacts. In the event of a large or very large oil spill, many of the adverse effects discussed would occur. These have been described for each resource in **Sections 3.1** to **3.4**. Depending on the location and extent of oil and gas operations and other permitted activities and adopted mitigation, unavoidable adverse effects could include the effects listed below. Note that this list presents only a summary of possible unavoidable adverse effects. Please refer to Section 4.9 of the 2012 Final IAP/EIS (BLM 2012) for a more complete discussion of similar unavoidable adverse effects that could occur post-leasing.

- Loss of soil productivity and sand and gravel resources, largely from construction of roads and pads and gravel mine development
- Changes in surface flow and drainage patterns due to construction of roads and pads and surface water withdrawal for ice roads, dust abatement, and operations
- Contribution of greenhouse gases to global climate change resulting from production and consumption of oil and gas extracted from the Reserve
- Loss of vegetation habitat, including wetlands, due to construction of roads and pads and gravel mine development
- Loss, alteration, or fragmentation of wildlife habitat
- Changes in wildlife migration or travel patterns
- Continued change in access to and availability of subsistence resources

3.6 RELATIONSHIP BETWEEN LOCAL SHORT-TERM USES AND LONG-TERM PRODUCTIVITY

This section discusses the short-term effects of the leasing alternatives, including the potential use of the planning area for oil and gas exploration and development, versus the maintenance and enhancement of potential long-term productivity of the planning area's environmental resources.

Short-term in this discussion refers to the total duration of activities that could occur as a result of the leasing alternatives, primarily oil and gas exploration and production, whereas long-term refers to an indefinite period extending beyond the termination of the action. Specific impacts vary in kind, intensity, and duration according to the activities occurring at any given time. Activities during the production life of oil and gas leases executed based on the decision in the ROD for this EIS may result in chronic impacts over a longer period. Over the long term—several decades after completion of abandonment activities—natural environmental balances are generally expected to be restored, though that balance would not for all resources mean a return to the exact state prior to original disturbance.

For a discussion of short-term uses of the planning area for hydrocarbon development and production activities versus the maintenance and enhancement of potential long-term productivity of environmental resources of the planning area, see **Sections 3.1** to **3.4** of this document, and see Section 4.10 of the NPR-A EIS (BLM 2012) for a description of these uses that could occur from the indirect impacts that would occur post-leasing.

3.7 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES

Irreversible or irretrievable commitments of resources refer to impacts on or losses of resources that cannot be reversed or recovered. A detailed description of irreversible or irretrievable commitments of resources from oil and gas development that could occur from the indirect impacts that would occur post-leasing is in Section 4.11 of the NPR-A EIS (BLM 2012). There would be some irreversible or irretrievable commitments of resources that are described in greater detail in **Sections 3.1** to **3.4**, as follows:

- Removal of hydrocarbons from the reservoir
- Energy consumption associated with the exploration, construction, and operation phases
- Permanent ground disturbance and permanent change resulting from gravel removal
- Surface water consumption for drilling and other industrial purposes with wastewater disposal via underground injection
- Loss of visual resource quality in the NPR-A
- Loss or abandonment of wildlife habitat
- Loss or change in subsistence use of the planning area, depending on final abandonment plans

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Glossary

Abandonment: The proper closure of a facility, piping, or well, whose use has been discontinued, meeting all applicable state and federal regulations, stipulations, required operating procedures, and best management practices.

Acidophilus: Acid-loving (as in bacteria or plants); growing well in an acid medium.

Active floodplain: The flat area along a waterbody where sediments are deposited by seasonal or annual flooding; generally demarcated by a visible high-water mark.

Aerial: Consisting of, moving through, found in, or suspended in the air.

Alluvial: Sedimentary material consisting mainly of coarse sand and gravel.

Alternatives: The different means by which objectives or goals can be attained; one of several policies, plans, or projects proposed for decision-making.

Ambient: Used to describe the environment as it exists at the point of measurement and against which changes (impacts) are measured.

Ambient air quality standard: Air pollutant concentrations of the surrounding outside environment that cannot legally be exceeded during fixed time intervals and in a specific geographic area.

Amphidromous: Describes fish that spawn and overwinter in rivers and streams but migrate during the ice-free summer from these freshwater environments into coastal waters for months to feed.

Anadromous: Describes fish that mature in the sea and swim up freshwater rivers and streams to spawn. Salmon, steelhead, and sea-run cutthroat trout are examples.

Anchor field: An oil and gas field containing sufficient quantities of recoverable oil and gas to support the construction of infrastructure and processing facilities; satellite fields can then be constructed using the anchor field facilities.

Ancillary data: Data other than instrument data required to perform an instrument's data processing.

Anoxic: The condition of an environment in which free oxygen is lacking or absent

Anthropogenic: Of, relating to, or resulting from the influence of humans on nature.

Anticline: An inverted bowl-shaped structure formed when sedimentary rock layers are folded to produce an arch or elongated dome.

Aquatic: Growing, living in, frequenting, or taking place in water; in this EIS, used to indicate habitat, vegetation, and wildlife in freshwater.

Aqueous film-forming foam (AFFF): A foam used for fire suppression that cools the fire and prevents the fuel from coming in contact with oxygen by coating it.

Archaeological resource: Place(s) where the remnants (e.g., artifacts) of a past culture survive in a physical context that allows for the interpretation of these remains. Archaeological resources can be districts, sites, buildings, structures, or objects and can be prehistoric or historic in nature.

Aromatic hydrocarbon: A hydrocarbon with a molecular structure involving one or more benzene unsaturated resonant rings of six carbon atoms, and having properties similar to benzene, which is the simplest of the aromatic hydrocarbons.

Aufeis: Thick ice that builds up as a result of repeated overflow.

Authorized Officer (BLM): Designated BLM personnel responsible for a certain area of a project; for this EIS, generally this would be the BLM State Director.

Available: When referring to oil and gas leasing, available lands could be offered. Lands that are already leased could be offered for leasing if the existing lease ends.

Bank: (1) The rising ground bordering a lake, river, or sea; or of a river or channel, for which it is designated as right or left as the observer is facing downstream. (2) An elevation of the sea floor or large area, located on a continental (or island) shelf and over which the depth is relatively shallow but sufficient for safe surface navigation (e.g., Georges Bank); a group of shoals. (3) In its secondary sense, used only with a qualifying word such as “sandbank,” “gravel bank,” or “spoil bank,” a shallow area consisting of shifting forms of silt, sand, mud, and gravel.

Barrel: Unit of measurement consisting of 42 gallons of oil or other fluid.

Baseline data: Data gathered before a proposed action to characterize pre-development site conditions.

Biodegradable: Capable of being broken down by the action of living organisms, such as microorganisms.

Biological assessment (BA): A document prepared by or under the direction of a federal agency; addresses listed and proposed species and designated and proposed critical habitat that may be in the action area and evaluates the potential effects of the action on such species and habitat.

Black water: Discharge that includes wastewater from any or all of the following: toilets, urinals, and sewage treatment systems.

Bonding capacity: An amount, determined by market analysts, based on a government entity’s prior bonding experience, actual repayment performance, and its ability to service future, periodic debt. It affects the ability of municipalities to issue and sell bonds to generate funds for capital improvements.

Bore-hole: The opening in the ground that is created when drilling a well; may refer to the inside diameter of the bore-hole wall, the rock face that bounds the drilled hole.

Bottom-fast ice: Ice that is firmly attached or grounded to the bottom of a waterbody, which is often frozen from top to bottom.

Brackish: Water that is intermediate between saltwater and freshwater; often occurs at the mouths of rivers, where freshwater mixes with saltwater.

Brine: General description of water that is produced with oil. The water is associated with the oil-producing formation and can have varying amounts of dissolved salts.

Brood: A group of young birds being cared for by an adult bird; typically the surviving hatchlings from one or more clutches of eggs.

Bureau of Land Management (BLM): An agency of the United States government, under the US Department of the Interior, responsible for administering certain public lands of the United States.

Burin: A tool flaked into a chisel point for inscribing or grooving bone, wood, leather, stone, or antler.

Calving area: A large area where large mammals, particularly ungulates such as caribou, congregate to give birth to their young.

Capital expenses: The money spent to purchase or upgrade physical assets, such as buildings or machinery.

cfs: Cubic feet per second; 1 cfs equals 448.33 gallons per minute.

Class I air quality area: One of 156 protected areas, such as national parks over 6,000 acres, wilderness areas over 5,000 acres, national memorial parks over 5,000 acres, and international parks that were in existence as of August 1977, where air quality should be given special protection. Federal Class I areas are subject to maximum limits on air quality degradation called air quality increments (often referred to as prevention of significant deterioration [PSD] increments). All areas of the United States not designated as Class I are Class II areas. The air quality standards in Class I areas are more stringent than national ambient air quality standards.

Class II air quality area: All areas of the country not designated Class I, including everything from non-Class I areas to urban areas. A greater amount of air pollution can be added to these areas than Class I.

Code of Federal Regulations (CFR): A codification of the general and permanent rules published in the *Federal Register* by the executive departments and agencies of the federal government.

Commercial field: Oil or natural gas fields that can be produced such that they provide a suitable return on investment.

Commercial oil or natural gas reserves: Resources that can be produced such that they provide a suitable return on investment.

Commercially recoverable: See *Commercial oil or natural gas reserves*, above.

Comprehensive Environmental Response Compensation and Liability Act of 1980 (CERCLA): Authorizes funds administered by the Environmental Protection Agency to identify and clean up hazardous waste sites; also known as Superfund.

Concern: A point, matter, or question raised by management or the public that must be addressed in the planning process.

Confluence: A junction of two or more flowing bodies of water joined to form a single channel.

Conglomerate: Sedimentary rock consisting of gravel and small boulders.

Controlled surface use (CSU): A category of moderate constraint stipulations that allows some use and occupancy of public land, while protecting identified resources or values. Applicable to fluid mineral leasing and all activities associated with fluid mineral leasing, such as truck-mounted drilling and geophysical exploration equipment off designated routes and construction of wells and pads. CSU areas are open to fluid mineral leasing, but the stipulation allows the BLM to require special operational constraints or to shift the activity more than 656 feet to protect the specified resource or value.

Consistency determination: A finding by a state or federal agency that a project or agency action is consistent with a required agency program, guideline, or regulation, such as the Alaska Coastal Zone Management Program.

Consultation: Exchange of information and interactive discussion; when capitalized it refers to consultation mandated by statute or regulation that has prescribed parties, procedures, and timelines, such as Consultation under NEPA or Section 7 of the Endangered Species Act.

Council on Environmental Quality (CEQ): An advisory council to the president, established by the National Environmental Policy Act of 1969. It reviews federal programs for their effect on the environment, conducts environmental studies, and advises the president on environmental matters.

Criteria: Data and information that are used to examine or establish the relative degrees of desirability of alternatives or the degree to which a course of action meets an intended objective.

Criteria air pollutants: The six most common air pollutants in the US: carbon monoxide (CO), lead (Pb), nitrogen dioxide (NO_2), ozone (O_3), particulate matter (both PM_{10} and $PM_{2.5}$ inhalable and respirable particulates), and sulfur dioxide (SO_2). Congress has focused regulatory attention on these six pollutants because they endanger public health and the environment, are widespread throughout the US, and come from a variety of sources. Criteria air pollutants are typically emitted from many sources in industry, mining, transportation, electricity generation, energy production, and agriculture.

Cultural resources: The remains of sites, structures, or objects used by humans in the past, historic or prehistoric.

Cumulative effect or impact: The impact on the environment that results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions, regardless of what agency (federal or non-federal) or person undertakes such actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over time.

Deferred: When referring to oil and gas leasing, indicates that lands would not be offered for lease until a specified period has expired. For example, a 10-year deferral would mean that the deferred lands would not be offered for leasing until for 10 years after the Record of Decision establishes the 10-year deferral.

Demersal: Living near, deposited on, or sinking to the seabed.

Density: The number of individuals per a given unit area.

Deposit: A natural accumulation, as of precious metals, minerals, coal, gas, and oil, that may be pursued for its intrinsic value, such as a gold deposit.

Development: The phase of petroleum operations that occurs after exploration has proven successful and before full-scale production. The newly discovered oil or gas field is assessed during an appraisal phase, a plan to fully and efficiently exploit it is created, and additional wells are usually drilled.

DEW-Line: Distant Early Warning Line. A site designed and built during the Cold War as the primary line of air defense warning of an “over the pole” invasion of North America.

Dilution: Mixing or thinning and therefore decreasing a certain strength or concentration.

Dispersion: Distributing or separating into lower concentrations or less dense units.

Dissociable: Able to break up into simpler chemical constituents.

Diversity: An expression of community structure; high, if there are many equally abundant species; low, if there are only a few equally abundant species; the distribution and abundance of different plant and animal communities and species in the area covered by a land and resource management plan.

Draft Environmental Impact Statement (DEIS): The draft statement of the environmental effects of a major federal action, which is required under section 102 of the National Environmental Policy Act and released to the public and other agencies for comment and review.

Drilling fluid (mud): A preparation of water, clay, and chemicals circulated in a well during drilling to lubricate and cool the drill bit, flush rock cuttings to the surface, prevent sloughing of the sides of the hole, and prevent the flow of formation fluids into the bore-hole or to the surface.

Drill pad: A drilling site, usually constructed of local materials, such as gravel.

Duck pond: A small, flat-bottomed plastic receptacle placed under a vehicle to catch and contain any contaminated fluids that may melt or drip from the underside of the vehicle.

Economically recoverable: See *Commercial oil or gas reserves*, above.

Effect: Environmental change resulting from a proposed action. Direct effects are caused by the action and occur at the same time and place, while indirect effects are caused by the action but are later in time or farther removed in distance, although still reasonably foreseeable. Indirect effects may include growth-inducing and other effects related to induced changes in the pattern of land use, population density, or growth rate and related effects on air and water and other natural systems, including ecosystems. Effect and impact are synonymous, and both are used in this document.

Employment: Labor input into a production process, measured in the number of person-years or jobs; the number of jobs required to produce the output of each sector. A person-year is approximately 2,000 working hours by one person working the whole year or by several persons working seasonally. A job may be 1 week, 1 month, or 1 year.

Endangered species: Any species of animal or plant that is in danger of extinction throughout all or a significant portion of its range; plant or animal species identified by the Secretary of the Interior as endangered, in accordance with the 1973 Endangered Species Act.

Energy budget: The flow of energy through an organism or ecosystem. For an organism, it is the amount of energy being absorbed (e.g., food) in relation to the amount of energy expended and lost as heat.

Environment: The physical conditions of an area, such as one that would be affected by a proposed project, such as land, air, water, minerals, flora, fauna, ambient noise, and objects of historic or aesthetic significance; the sum of all external conditions that affect an organism or community to influence its development or existence.

Environmental assessment (EA): A concise public document, for which a federal agency is responsible, that serves to (1) briefly provide sufficient evidence and analysis for determining whether to prepare an environmental impact statement or a finding of no significant impact; (2) aid an agency's compliance with the National Environmental Policy Act when no environmental impact statement is necessary; and, (3) facilitate preparation of an environmental impact statement when one is necessary. .

Environmental impact statement (EIS): An analytical document prepared under the National Environmental Policy Act that portrays the potential impacts of the environment of a preferred action and its possible alternatives. An EIS is developed for use by decision-makers to weigh the environmental consequences of a potential decision.

Environmental justice: The fair treatment and meaningful involvement of all people, regardless of natural origin or income, with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. Fair treatment means that no group of people, including racial, ethnic, or socioeconomic groups, should bear a disproportionate share of the negative environmental consequences resulting from industrial, municipal, and commercial operations or the execution of federal, state, local, and tribal programs and policies. Executive Order 12898 directs federal agencies to achieve environmental justice as part of their missions by identifying and addressing disproportionately high adverse effects of agency programs, policies, and activities, on minority and low-income populations

Erosion: The wearing away of the land surface by running water, wind, ice, or other geologic agents, including gravitation creep.

Eskimo: An ethnonym (name given to a group by another group) referring to speakers of the Inuit language family who live in the Arctic and Subarctic regions of North America—Canada, Greenland, and Alaska—and eastern Siberia.

Essential fish habitat (EFH): As defined by Congress in the interim final rule (62 FR 66551), "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity." For the purpose of interpreting the definition of EFH habitat, "waters" are aquatic areas and their associated physical, chemical, and biological properties; "substrate" is sediment underlying the waters; "necessary" refers to the habitat required to support a sustainable fishery and the managed species contribution to a healthy ecosystem; and "spawning, breeding, feeding, or growth to maturity" covers all habitat types that a species uses throughout its life cycle.

Estuary: A partially enclosed body of water formed where freshwater from rivers and streams flows into the ocean, mixing with the salty seawater. Estuaries and the lands surrounding them are places of transition from land to sea, and from freshwater to saltwater.

Ethnographic: Of or pertaining to the descriptive and analytical study of the culture of particular self-defined groups or communities.

Exception: A one-time exemption to a lease stipulation, determined on a case-by-case basis.

Exploration: The search for economic deposits of minerals, gas, oil, or coal through the practices of geology, geochemistry, geophysics, drilling, shaft sinking, and mapping.

Exploratory unit: Normally embrace a prospective area delineated on the basis of geological or geophysical inference and permit the most efficient and cost-effective means of developing underlying oil and gas resources.

°F: Degrees Fahrenheit.

Fast-ice zone: Area along the coast covered by sea ice that is contiguous with and attached to the shoreline.

Feasible: Capable of being accomplished in a successful manner within a reasonable time, taking into account economic, environmental, legal, social, and technological factors.

Final environmental impact statement (final EIS): A revision of the draft environmental impact statement that includes public and agency comments on the draft.

Fisheries habitat: Streams, lakes, and reservoirs that support fish populations.

Fishery: The act, process, occupation, or season of taking an aquatic species.

Floodplain: The lowland and relatively flat area adjoining inland waters, including, at a minimum, that area subject to a 1 percent or greater chance of flooding in any given year.

Fluvial: Of or relating to a stream or river.

Fossil: Evidence or remnant of a plant or animal preserved in the earth's crust, such as a skeleton, footprint, or leaf print.

Fossil fuel: Petroleum, natural gas, and coal; fuel derived from biological material that was deposited into sedimentary rocks.

Frequency: The number of samples in which a plant or animal species occurs, divided by the total number of samples.

Fugitive dust: Particles suspended randomly in the air, usually from road travel, excavation, or rock loading operations.

Game management unit (GMU): A geographic division made by the Alaska Department of Fish and Game for managing fish and wildlife. Different GMUs have different hunting and fishing seasons, bag limits, and other harvest rules.

Geology: The scientific study of the origin, history, and structure of the earth; the structure of a specific region of the earth's surface.

Geomorphic: Pertaining to the structure, origin, and development of the topographical features of the earth's crust.

Gill net: Made of one or more layers of mesh, used to catch fish by entanglement as they attempt to swim through the net.

Glacial drift: Unsorted sediments deposited by glaciers and not subsequently reworked by water; coarse-grained materials, such as rock and sand, suspended in a fine-grained matrix, such as silt. The term applies to all mineral material transported by a glacier and deposited directly by or from the ice or by running water emanating from a glacier.

Global warming: An increase over time of the average temperature of the earth's atmosphere and oceans. It is generally used to describe the temperature rise over the past century or so and the effects of humans on the temperature rise.

Gray water: Discharge that includes wastewater from any or all of the following: kitchen sink, shower, drinking water, and laundry.

Greenhouse effect: A process by which thermal radiation from a planetary surface is absorbed by atmospheric greenhouse gases and is reradiated in all directions. Since part of this re-radiation is toward the earth's surface and the lower atmosphere, it elevates the average surface temperature above what it would be in the absence of the gases.

Greenhouse gas (GHG): A gas that absorbs and emits thermal radiation in the lowest layers of the atmosphere. This process is the fundamental cause of the greenhouse effect. The primary greenhouse gases that are considered air pollutants are carbon dioxide, methane, nitrous oxide, and chlorofluorocarbons.

Habitat: The natural environment of a plant or animal, including all biotic, climatic, and soil conditions, or other environmental influences affecting living conditions. The place where an organism lives.

Haul-out: A land or sea-ice location where pinnipeds exit the water for birthing, molting, nursing, resting, and breeding.

Hazardous air pollutants (HAPs): Also known as toxic air pollutants, those that cause or may cause cancer or other serious health effects, such as reproductive effects or birth defects, or adverse environmental and ecological effects. The Environmental Protection Agency is required to control 187 hazardous air pollutants. Examples of HAPs are benzene (found in gasoline), perchlorethlyene (emitted from dry cleaning facilities), and methylene chloride (used as a solvent).

Hazardous waste: As defined by the Environmental Protection Agency, a waste that exhibits one or more of the following characteristics: ignitability, corrosivity, reactivity, or toxicity. Hazardous wastes are listed in 40 CFR 261.3 and 171.8.

Headwaters: The upper reaches of a stream where it forms.

Hydrocarbon: A naturally occurring organic compound composed of hydrogen and carbon. Hydrocarbons can occur in molecules as simple as methane (one carbon atom with four hydrogen atoms), but also as highly complex molecules, and can occur as gases, liquids, or solids. The molecules can have the shape of chains, branching chains, rings, or other structures. Petroleum is a complex mixture of hydrocarbons.

Hydrologic system: The combination of all physical factors, such as precipitation, stream flow, snowmelt, and groundwater that affect the hydrology of a specific area.

Impermeable: Not permitting passage of fluids through its mass.

Impoundment: The collection and confinement, usually of water (in the case of mining, tailings materials), in a reservoir or other storage area.

Increment: An amount of change from an existing concentration or amount, such as air pollutant concentrations.

Indigenous: Having originated in and being produced, growing, living, or occurring naturally in a particular region or environment.

Indirect impact: Caused by an action but later in time or farther removed in distance, although still reasonably foreseeable.

Infrastructure: The underlying foundation or basic framework; substructure of a community, such as schools, police, fire services, hospitals, water, and sewer systems; permanent structures; does not include subsistence camps and cabins or single-season ice structures.

Insect-relief area: An area of the North Slope with relatively low numbers of insects where caribou travel for relief from insects.

Integrated activity plan (IAP): A type of land use plan developed to guide the BLM in appropriate management of NPR-A lands.

Interstitial ice: Found in cavities or lodged between soil grains or rock crevices.

Irretrievable: Applies to losses of production, harvest, or commitment of renewable natural resources. For example, some or all of the wildlife forage production from an area is irretrievably lost during the time an area is used as an oil or gas development site. If the use changes, forage production can be resumed. The production lost is irretrievable, but the act is not irreversible.

Irreversible: A term that applies primarily to the use of nonrenewable resources, such as minerals or cultural resources, or to those factors that are renewable only over long time spans, such as soil productivity. Irreversible also includes loss of future options.

Isobath: Depth interval contour, as commonly mapped for lake or ocean bottoms.

Jurisdictional responsibility: A geographical area in which the agency or department has the power and the right to administer presiding regulations, statues, and practices.

Jurisdictional wetland: A wetland area delineated and identified by specific technical criteria, field indicators, and other information for the purposes of public agency jurisdiction. The US Army Corps of Engineers regulates dredging and filling activities associated with jurisdictional wetlands. Other federal agencies that can become involved with matters that concern jurisdictional wetlands are the US Fish and Wildlife Service, the Environmental Protection Agency, and the Natural Resource Conservation Service.

Landform: Any physical, recognizable form or feature on the earth's surface having a characteristic shape, which is produced by natural causes. Landforms provide an empirical description of similar portions of the earth's surface.

Land management: The intentional process of planning, organizing, programming, coordinating, directing, and controlling land use actions.

Landscape: The sum total of the characteristics that distinguish a certain area on the earth's surface from other areas; these characteristics are a result not only of natural forces but also of human occupancy and use of the land; an area composed of interacting and interconnected patterns of habitats (ecosystems), which are repeated because of geology, landforms, soils, climate, biota, and human influences throughout the area.

Land status: The ownership status of lands.

Land use allocation: The assignment of a management emphasis to particular land areas with the purpose of achieving the goals and objectives of some specified use, such as campgrounds, wilderness, logging, and mining.

Laterally discontinuous: Not continuous in the horizontal plane. For example, in an area with laterally discontinuous permafrost, the permafrost is not uniformly found across the entire area without interruption.

Lead: Long cracks in the ice, used by both whales and boats to travel through the water.

LiDAR (Light Detection and Ranging): A remote sensing method that uses light in the form of a pulsed laser to measure ranges (variable distances) to the Earth.

Liquid natural gas: Natural gas that has been liquefied by reducing its temperature to -260 °F at atmospheric pressure. It will remain as a liquid at -116 °F and 673 pounds per square inch above atmospheric pressure.

Listed species: Species that are listed as threatened or endangered under the Endangered Species Act of 1973 (as amended).

Long-term impacts: Impacts that normally result in permanent changes to the environment. An example is the loss of habitat due to development of a gravel pit. For each resource, the definition of long-term may vary.

Maktak: Eskimo delicacy consisting of the skin and the thin layer of subcutaneous fat of whales.

Management activity: A human activity imposed on a landscape for the purpose of harvesting, traversing, transporting, or replenishing natural resources.

Management area: An area delineated on the basis of management objective prescriptions.

Management concern: An issue, problem, or condition that influences the range of management practices identified in a planning process.

Management direction: A statement of multiple use and other goals and objectives, and the associated management prescriptions, standards, and guidelines for attaining them (36 CFR 219.3).

Masu: A starchy tuber found in arctic and subarctic regions (vernacular is "Eskimo potato").

Marine: Of, found in, or produced by the sea.

Memorandum of understanding (MOU): Usually documents an agreement reached among federal agencies.

Migratory: Moving from place to place, daily or seasonally.

Mitigation: Steps taken to: (1) avoid an impact altogether by not taking a certain action or parts of an action; (2) minimize an impact by limiting the degree or magnitude of an action and its implementation; (3) rectify an impact by repairing, rehabilitating, or restoring the affected environment; (4) reduce or eliminate an impact over time by preserving and maintaining operations during the life of the action; and (5) compensate for an impact by replacing or providing substitute resources or environments (40 CFR 1508.20).

Modification: A change to a lease stipulation either temporarily or for the life of the lease.

NAD83 (North American Datum of 1983): An Earth-centered datum used to define the geodetic network in North America using an anchor point for the coordinate system.

National Environmental Policy Act (NEPA): An act declaring a national policy to encourage productive and enjoyable harmony between humankind and the environment; promote efforts to prevent or eliminate damage to the environment and biosphere and stimulate the health and welfare of humanity; enrich the understanding of the ecological systems and natural resources important to the nation; and establish a Council on Environmental Quality.

Net present value (NPV): The difference between the discounted value (benefits) of all outputs to which monetary values or established market prices are assigned and the total discounted costs of managing the planning area.

National Pollutant Discharge Elimination System (NPDES): A program authorized by Sections 318, 402, and 405 of the Clean Water Act and implemented by regulations 40 CFR 122. The NPDES program requires permits for the discharge of pollutants from any point source into waters of the United States.

No surface occupancy (NSO): An area that is open for mineral leasing but does not allow the construction of surface oil and gas facilities in order to protect other resource values.

Non-Associated Gas: Gas in a reservoir having little or no crude oil.

NO_x: Mono-nitrogen oxides, including nitric oxide (NO) and nitrogen dioxide (NO_2). It is formed when naturally occurring atmospheric nitrogen and oxygen are combusted with fuels in automobiles, power plants, industrial processes, and home and office heating units.

Objective: A concise, time-specific statement of measurable planned results that respond to pre-established goals. An objective form the basis for further planning to define the precise steps to be taken and the resources to be used to achieve identified goals.

Oiled: Having oil on skin, fur, or feathers after coming in contact with an oil spill.

Ordinary high water mark: A line on the shore established by the fluctuations of water and indicated by physical characteristics such as clear, natural line impressed on the bank, shelving, changes in the character of soil, destruction of terrestrial vegetation, the presence of litter and debris, or other appropriate means that consider the characteristics of the surrounding areas.

Orthophyll: Vegetation with soft and thin leaves mostly of ordinary texture.

Ozone: Form of oxygen found largely in the stratosphere; a product of the reaction between ultraviolet light and oxygen.

Paleontological resources: Any fossilized remains, traces, or imprints of organisms, preserved in or on the earth's crust, from prehistoric or geologic times, as represented by the fossils of plants, animals, and other organisms.

Particulates: Small particles suspended in the air, generally considered pollutants.

Pelagic: Pertaining to the ocean and especially to animals (typically marine mammals, birds, or fish) that live at the surface of the ocean away from the coast.

Per capita income: Total income divided by the total population.

Performance-based stipulation: Applied to a lease that provides a stated objective that must be met, along with requirements and guidelines, but provides some leeway as to how that objective can be met and maintained by the lessee (compare with prescriptive-based stipulation).

Permafrost: Permanently frozen ground.

Permanent oil and gas facilities: Production facilities, pipelines, roads, airstrips, production pads, docks, seawater treatment plants, and other structures associated with oil and gas production that occupy land for more than one winter season. Material sites and seasonal facilities, such as ice roads, are excluded, even when the pads are designed for use in successive winters.

Permeability: The property or capacity of a porous rock, sediment, or soil for transmitting a fluid; a measure of the relative ease of fluid flow under unequal pressure.

Photoperiod: In reference to cycles of light and darkness, the length of time that uninterrupted light is present, generally the length of daylight in a given 24-hour period.

Physiographic province: A region having a particular pattern of relief features or land forms that differs significantly from that of adjacent regions, for example, the Arctic Coastal Plain.

Pingo: A low conical hill or mound forced up by hydrostatic pressure in an area underlain by permafrost; consists of an outer layer of soil covering a core of solid ice. Pingos range from 20 to 525 feet high.

Planning area: An administrative unit determined by the Bureau of Land Management based on resources and management issues.

Plant community: A vegetation complex, unique in its combination of plants, that occurs in particular locations under particular influences. It is a reflection of integrated environmental influences on the site, such as soils, temperature, elevation, solar radiation, slope aspect, and precipitation.

Pollution: Human-caused or natural alteration of the physical, biological, and radiological integrity of water, air, or other aspects of the environment that produce undesired effects.

Polygon: A surface landform resulting from repeated freeze-thaw cycles common in permafrost areas. Polygons are bounded by troughs of ice or water and generally occur in networks that form regular geometric designs with multiple square sides of nearly equal lengths.

Polynyas: Nonlinear openings in the sea ice.

Pool: A subsurface oil accumulation.

Porosity: The ratio of the volume of void space in a material, such as sedimentary rock or sediments, to the volume of its mass.

Potable: Suitable, safe, or prepared for drinking, as in potable water.

Pot hunting: The removal or theft of artifacts from cultural resource sites by untrained individuals for profit and recreation.

Prescriptive-based stipulation: A stipulation applied to leases with exacting requirements applying to lessee activities (compare with performance-based stipulation).

Prevention of significant deterioration (PSD): A special permit procedure established in the Clean Air Act, as amended, to ensure that economic growth occurs in a manner consistent with the protection of public health and preservation of air quality-related values in national special interest areas.

Pristine: Pure, original, and uncontaminated.

Prospect: An area of exploration in which hydrocarbons have been predicted to exist in commercially recoverable quantities.

Public scoping: A process whereby the public is given the opportunity to provide oral or written comments about the influence of a project on an individual, the community, and the environment.

Pulse: A group of whales; the term is applied to whales migrating across the Chukchi and Beaufort seas, when there are more individuals in each pod of whales and more pods than usual.

Putrescible: Liable to decay.

Pyrogenic: Producing or produced by heat.

Raptor: Bird of prey; includes eagles, hawks, falcons, and owls.

Recharge: Absorption and addition of water into the zone of saturation.

Record of Decision (ROD): A document separate from, but associated with, an environmental impact statement, which states the decision, identifies alternatives (specifying which were environmentally preferable), and states whether all practicable means to avoid environmental harm from the alternative have been adopted, and, if not, why not (40 CFR 1505.2).

Recoverable reserves: Oil and gas reserves that may be recoverable by the application of technology but that are not necessarily commercially recoverable.

Regulated air pollutants: Pollutants first set forth in the Clean Air Act of 1970 and the basis on which the federal government and state regulatory agencies have established emission thresholds and regulations. Regulated air pollutants include criteria air pollutants, hazardous air pollutants, volatile organic compounds, and greenhouse gases. The same pollutant may be regulated under more than one of the regulatory standards.

Reservoir (oil or gas): A subsurface body of rock having sufficient porosity and permeability to store and transmit fluids. Sedimentary rocks are the most common reservoir rocks; this is because they have more porosity than most igneous and metamorphic rocks and form under temperature conditions at which hydrocarbons can be preserved. A reservoir is a critical component of a complete petroleum system.

Resident: A species that is found in a particular habitat for a particular period, such as a winter or summer resident, as opposed to a species found only when passing through during migration.

Required operating procedure (ROP): Carried out during proposal implementation and based on laws, regulations, executive orders, BLM planning manuals, policies, instruction memoranda, and applicable planning documents.

Rideup: A raised-relief ice formation that is formed when a moving ice sheet is forced up and over other structures such as land or ice.

Riffles: Stream segments where the water is relatively shallow, current velocity is relatively high, and sediments are coarse; riffles are located between areas of deeper, slower pools of water.

Right-of-way (ROW): BLM authorization granted to a holder for the use or occupancy of public lands; examples are roads, pipelines, power lines, and fiber optic lines.

Rift zone: Zone of faulting where rocks are pulled apart.

Riparian: Occurring next to streams and rivers and directly influenced by water. A riparian community is characterized by certain types of vegetation, soils, hydrology, and fauna and requires free or unbound water or conditions more moist than that normally found in the area.

Risked mean: The arithmetic average of all possible resource outcomes weighted by their probabilities. Risked (unconditional) estimates of such resources as oil or natural gas take into consideration the possibility that the area may be devoid of those resources. Statistically, the risked mean may be determined by multiplying the mean of a conditional distribution by the related probability of occurrence.

Rolligon: A brand name or make of wheeled vehicle that exerts low pressure on the ground and is designed to travel across sensitive areas, such as tundra, with minimal disturbance.

Satellite field: An oil reserve near an existing oil development, allowing shared use of the infrastructure.

Scenic River: River designation, under the federal Wild and Scenic Rivers Program, on the basis of undisturbed and scenic character. Scenic rivers are given special management criteria by federal agencies.

Scoping period: A part of the National Environmental Policy Act process; early and open activities used to determine the scope and significance of the issues and the range of actions, alternatives, and impacts to be considered in an environmental impact statement (40 CFR 1501.7).

Screeding: The use of a straight surface or purpose-made tool to smooth and flatten concrete or asphalt after its placement on a surface.

Sediments: Unweathered geologic materials generally laid down by or within waterbodies; the rocks, sand, mud, silt, and clay at the bottom and along the edge of lakes, streams, and oceans.

Seismic: Relating to or denoting geological surveying methods involving vibrations produced artificially by explosions.

Sensitive species: Plant or animal species that are susceptible or vulnerable to activity impacts or habitat alterations. Species that have appeared in the *Federal Register* as proposed for classification or are under consideration for official listing as endangered or threatened species.

Setback: A distance by which a structure or other feature is set back from a designated line.

Short-term impact: An impact occurring during project construction and operation and normally ceasing at project closure and reclamation. (For each resource, the definition may vary.)

Significant: The description of an impact that exceeds a certain threshold level. Requires consideration of both context and intensity. The significance of an action must be analyzed in several contexts, such as society as a whole, and the affected region, interests, and locality. Intensity refers to the severity of impacts, which should be weighted along with the likelihood of its occurrence.

SO_x: Sulfur oxides, including sulfur dioxide (SO_2); a product of vehicle tailpipe emissions.

Sociocultural: Of, relating to, or involving a combination of social and cultural factors.

Socioeconomic: Pertaining to or signifying the combination or interaction of social and economic factors.

Soil horizon: A layer of soil approximately parallel to the land surface that differs from adjacent genetically related layers in physical, chemical, and biological properties.

Solid waste: Garbage, refuse, or sludge produced during oil and gas exploration and development activities.

Spawning: Production, deposition, and fertilization of eggs by fish.

Special Recreation Permit (SRP): BLM authorization to use public lands and waters for commercial recreation

Spill prevention control and countermeasure (SPCC) plan: Required by the Environmental Protection Agency to be on file within 6 months of project inception; a contingency plan for avoiding, containing, and responding to spills or leaks of hazardous materials.

Spine road: The all-season gravel road connecting the oil and gas facilities at Kuparuk (Kuparuk Base Camp) with those at Prudhoe Bay (Prudhoe Bay Operations Center).

Standard: A model, example, or goal established by authority, custom, or general consent as a rule for the measurement of quantity, weight, extent, value, or quality.

Stipulation: A requirement or condition placed by the Bureau of Land Management on the leaseholder for operations the leaseholder might carry out within that lease. The Bureau of Land Management develops stipulations that apply to all future leases in the NPR-A.

Stratigraphic trap: An oil or gas reservoir in which the hydrocarbons are trapped because of a lateral change in the physical characteristics of the reservoir or a change in the lateral continuity of the rocks.

Strike: The act of throwing a darting gun harpoon with a black powder or penthrite bomb into a whale. A strike may or may not result in a dead whale, which may or may not result in a landed whale. The International Whaling Commission considers and counts the number of strikes and landed whales in its quota allocation to the US government (and hence to the Alaska Eskimos). Unused strikes can be transferred to other individuals or groups harvesting whales.

Subsistence: Harvesting of plants and wildlife for food, clothing, and shelter; attaining most of one's material needs, such as food and clothing materials, from wild animals and plants.

Talik: An unfrozen section of ground found above, below, or within a layer of discontinuous permafrost. These layers can also be found beneath waterbodies in a layer of continuous permafrost.

Technically recoverable: Amount of oil or gas that can be recovered from a formation using current technology and practices.

Tectonic plate: A large, thin, rigid plate that moves relative to other plates on the outer surface of the earth.

Terrestrial: Of or relating to the earth, soil, or land; inhabiting the earth or land.

Thermokarst: Land-surface configuration that results from the melting of ground ice in a region underlain by permafrost. In areas that have appreciable amounts of ice, small pits, valleys, and hummocks form when the ice melts and the ground settles unevenly.

Threatened species: A plant or animal likely to become endangered throughout all or a significant portion of its range within the foreseeable future.

Timing limitation (TL): A moderate constraint, this is applicable to fluid mineral leasing, all activities associated with fluid mineral leasing, such as truck-mounted drilling and geophysical exploration equipment off designated routes, and construction of wells and pads, and other surface-disturbing activities, such as those not related to fluid mineral leasing. Areas identified for TL are closed to fluid mineral exploration and development, surface-disturbing activities, and intensive human activity during identified time frames. This stipulation does not apply to operation and basic maintenance, including associated vehicle travel, unless otherwise specified. Construction, drilling, completions, and other operations considered to be intensive are not allowed. Intensive maintenance, such as workovers on wells, is not permitted. TLs can overlap spatially with no surface occupancy and controlled surface use, as well as with areas that have no other restrictions.

Total petroleum system: The combination of geologic components and processes necessary to generate and store hydrocarbons, including a mature source rock, migration pathway, reservoir rock, trap, and seal; includes all the petroleum generated by related source rocks and resides in a volume of mappable rocks. Geologic processes act on the petroleum system and control the generation, expulsion, migration, entrapment, and preservation of petroleum.

Traditional knowledge: An intimate understanding by indigenous peoples of their environment, which is grounded in a long-term relationship with the surrounding land, ocean, rivers, ice, and resources. This understanding includes knowledge of the anatomy, biology, and distribution of resources; animal behavior; seasons, weather, and climate; hydrology, sea ice, and currents; how ecosystems function; and the relationship between the environment and the local culture.

Transfer payment: Money that the government gives to citizens, such as Social Security, welfare, and unemployment compensation.

Trophic system: The process and organisms that move food energy through the ecosystem, often termed a food chain.

Tundra: Level or undulating treeless plain characteristic of northern Arctic regions, consisting of black mucky soil with permanently frozen subsoil and a dense growth of mosses, lichens, dwarf herbs, and shrubs.

Turbidity: A measure of the amount of suspended sediment in water.

Tussock: A small area of grass that is thicker or longer than the grass growing around it.

Unavailable: When referring to oil and gas leasing, unavailable lands would not be offered for oil and gas leasing.

Unconventional oil and gas: Reservoir oil and gas that cannot be efficiently extracted using conventional methods; examples are shale gas and tar sands.

Vertical support member (VSM): Pipe piling embedded in the ground to support the aboveground pipe in areas of thaw-unstable permafrost.

Vibroseis: A device that uses a truck-mounted vibrator plate coupled to the ground to generate a wave train up to 7 seconds in duration and comprising a sweep of frequencies. The recorded data from an upsweep or down sweep (increasing or decreasing frequency respectively) are added together and compared with the source input signals to produce a conventional-looking seismic section. The device is used increasingly in land surveys instead of explosives.

Volatile organic compound (VOC): A chemical that reacts in the atmosphere with nitrogen oxides in the presence of sunlight and heat to form ozone. VOCs contribute significantly to photochemical smog production and certain health problems. Examples of VOCs are gasoline fumes and oil-based paints.

Waiver: A permanent exemption to a stipulation or lease.

Waterbody: A jurisdictional Water of the United States (see 33 CFR 328.4). Examples of waterbodies include streams, rivers, lakes, ponds, and wetlands.

Waterflooding: The injection of water into geological reservoirs to maintain or increase pressure in the reservoir and thereby assist in the extraction of oil.

Water quality: The interaction between various parameters that determines the usability or non-usability of water for on-site and downstream uses. Major parameters that affect water quality are temperature, turbidity, suspended sediment, conductivity, dissolved oxygen, pH, specific ions, discharge, and fecal coliform.

Wetlands (biological wetlands): Those areas that are inundated or saturated by surface water or groundwater at a frequency and duration sufficient to support, and that under normal circumstance do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands include such habitats as swamps, marshes, and bogs (see jurisdictional wetlands).

Wild and Scenic Rivers: Those rivers or sections of rivers that are free of impoundments, with shorelines or watersheds still largely primitive and shorelines largely undeveloped but accessible in places by roads.

Wilderness: An area, in contrast with those areas where humans and their works dominate the landscape; recognized as an area where the earth and its community of life are untrammeled by humans, where humans are visitors who do not remain; further defined to mean an area of undeveloped federal land retaining its primeval character and influence, without permanent improvements or human habitation, that is protected and managed so as to preserve its natural conditions and with the following qualities:

- Generally appears to have been affected primarily by the forces of nature, with the imprint of humans substantially unnoticeable
- Has outstanding opportunities for solitude or a primitive and unconfined type of recreation
- Has at least 5,000 acres of land or is of sufficient size as to make practicable its preservation and use in an unimpaired condition
- May also contain ecological, geological, or other features of scientific, educational, scenic, or historic value